Specification No. K11027

N231
Replace Arc Jet Complex SVS Boiler

NASA Ames Research Center
Moffett Field, CA 94035

Approved for Construction
Moffett Field Permit Board

3/14/13

Chief Building Official
Permit No. 12P042

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SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for a description of work covered in this contract and is required for use in all projects

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM E 2114	Standard Terminology for Sustainability Relative to the Performance of Buildings

GREEN BUILDING INITIATIVE (GBI)

Green Globes	Green Globes(tm) US Green Building Rating System

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	Energy Star Energy Efficiency Labeling System

1.3 DEFINITIONS

Definitions pertaining to sustainable development are as defined in ASTM E 2114, and as specified.

a. "Environmentally preferable products" have a lesser or reduced effect on the environment in comparison to conventional products and services. This comparison may consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, or disposal of the product.

b. "Indoor environmental quality" is the physical characteristics of the building interior that impact occupants, including air quality, illumination, acoustics, occupant control, thermal comfort, daylighting, and views.

c. "Operational performance" is the functional behavior of the building as a whole or of the building components.

d. "Sustainability" is the balance of environmental, economic, and societal considerations.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Upon receipt of Government Furnished Equipment, the Contractor shall submit records in accordance with paragraph entitled, "Government Furnished Property," of this section.

Submit the following items to the COR:

Utility Outage Requests
Utility Connection Requests
Borrow Permits
Excavation Permits
Welding Permits
Burning Permits

1.5 WORK COVERED BY CONTRACT DOCUMENTS

1.5.1 Project Description

This project is located at the NASA Ames Research Center (ARC) entitled Replace Arc Jet Complex Steam Vacuum System (SVS) Boiler. The new, fully functional boiler plant to be constructed will be located north of existing building ARC Building N231 and west of the existing Arc Jet Complex Steam Vacuum System.

The base scope of work includes:

a. Three (3) low emission, high pressure steam boilers.

b. Deaerator heater and feedwater tank.

c. Boiler NOx reduction systems.

d. Bulk ammonia tank system.

e. Supporting and connecting piping.

f. Boiler plant controls.

g. Other major boiler plant mechanical equipment, including auxiliary boiler, combustion air fan, boiler, feedwater & chemical feed pumps, blowdown recovery heat exchanger, boiler makeup water softener package, flow measuring devices, backflow preventers, steam traps, flash tanks, control valve station, pressure reducing valve station, and safety valves.

h. Reinforced concrete slab foundation.

i. Structural steel canopy covering the full footprint of the new boiler plant.

j. Platforms and stairs for servicing boilers and feedwater/de-aerator tank.

k. Partial demolition and removal of NOx Sphere No. 6 foundations.

l. Demolition of site utilities within boundary of construction.

m. Demolition of room interior within new control room in N231 Arc Jet Complex Boiler Plant.

n. Electric distribution service.

o. Boiler control room in Building N231 Arc Jet Complex Boiler Plant.

p. Control room lighting, fire alarm, security, data and communication systems.

q. Gas and water utilities.

r. Earthwork, including grading and drainage improvements.

s. Asphalt pavement surrounding new boiler plant foundation slab.

t. Perimeter site fence with concrete ramps, manual sliding gates and card access man gate.

u. Site restoration.

v. Traffic control for streets affected by construction operations.

w. Component and integrated system testing.

The bid option scope of work includes:

BID OPTION 1 - NOX SPHERE 6

Demolition of (E) NOx Sphere 6, associated accessory buildings, tanks and piping of abandoned NOx system. Bid option includes all demolition work above ground shown within this boundary. Demolish scrubber sphere and structural supports, NOx scrubber tower, NOx scrubber surge holding tank, NOx scrubber surge waste tank, storage shed, chemical tank and associated piping.

BID OPTION 2 -BOILER AUXILIARY STEAM HEATING SYSTEM

Design, furnish and install auxiliary steam heating system for all three boilers to utilize heat exchanger in mud drum for maintaining boiler temperature above 250°F while main burners are shut off. Auxiliary heating system shall heat the two boilers intended for next day service. System shall be designed for automatic unattended service. Combining boiler auxiliary heating system with deaerator auxiliary heating system into one system is an acceptable alternative.

BID OPTION 3 - BOILER STACK ACCESS

Provide SVS Boiler stack platforms and caged ladders.

BID OPTION 4

Not Used.

BID OPTION 5 - N231 ARC JET COMPLEX BOILER PLANT RESTROOM

Remodel N231 Arc Jet Complex Boiler Plant restroom for ADA compliance. Provide shower room and tankless water heater.

BID OPTION 6 - N231 ARC JET COMPLEX BOILER PLANT PAINTING, PARKING AND CONTROL ROOM HVAC

Provide N231 Arc Jet Complex Boiler Plant control room replacement HVAC system, entry walkway and ADA ramp, parking lot paving and curbs, and painting of N231 Arc Jet Complex Boiler Plant east high bay wall.

BID OPTION 7 - N234A BOILER & FWDA DEMOLITION

Demolition of the (E) SVS Boiler and FWDA system located inside N234A. Demolish (E) mechanical equipment, unless specifically identified to remain. Equipment demolition scope includes all connecting piping, pumps, controls, instruments and electrical power, which are not required for other equipment identified to remain.

1.5.2 Building Information Modeling (BIM)

The Contractor shall construct the project utilizing Building Information Modeling procedures and requirements as set forth in the NASA BIM Scope of Services document, Appendix A, 'Building Information Modeling Scope of Services and Requirements For Construction Contractor In A Design-Bid-Build Process - Replace Arc Jet Complex SVS Boiler' dated April 24, 2012.

Upon award of the construction contract, the COR will provide to the Contractor Building Information Model (BIM) developed for this project by the AE. These models are for the use by the contractor in the development of the BIM required under the scope of service document referenced in this specification. The Contractor will not construe the A/E-developed BIM as meeting the whole or part of the requirements identified in scope of services document referenced in Appendix A. These requirements are the sole responsibility of the Contractor.

1.5.3 Location

The work shall be located at the Arc Jet Complex at Ames Research Center, Moffett Field, California, approximately as indicated. The exact location will be shown by the COR.

1.6 WORK RESCHEDULING

Contractor shall allow for a maximum of 21 calendar days where construction activity is prohibitive. Further allowance for 10 calendar days of excavation and subsurface activity abeyance shall be imposed where other construction activities are permitted. Government will provide 24 hour notification each time the restrictions are invoked.

Normal duty hours for work shall be from 6:00 a.m. to 5:00 p.m., Monday through Friday. Requests for additional work shall require written approval from the COR 7 days in advance of the proposed work period.

1.7 PROJECT ENVIRONMENTAL GOALS

Contractor shall distribute copies of the Environmental Goals to each subcontractor and the COR. The overall goal for design, construction, and operation is to produce a building that meets the functional program needs and incorporates the principles of sustainability. Specifically:

a. Preserve and restore the site ecosystem and biodiversity; avoid site degradation and erosion. Minimize offsite environmental impact.

b. Use the minimum amount of energy, water, and materials feasible to meet the design intent. Select energy and water efficient equipment and strategies.

c. Use environmentally preferable products and decrease toxicity level of materials used.

d. Use renewable energy and material resources.

e. Optimize operational performance (through commissioning efforts) in order to ensure energy efficient equipment operates as intended. Consider the durability, maintainability, and flexibility of building systems.

f. Manage construction site and storage of materials to ensure no negative impact on the indoor environmental quality of the building.

g. Reduce construction waste through reuse, recycling, and supplier take-back.

1.8 OCCUPANCY OF PREMISES

Building(s) will be occupied during performance of work under this Contract. Occupancy notifications will be posted in a prominent location in the work area.

Before work is started, the Contractor shall arrange with the COR a sequence of procedure, means of access, space for storage of materials and equipment, and use of approaches, corridors, and stairways.

1.9 EXISTING WORK

In addition to "FAR 52.236-9, Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements":

a. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.

b. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the COR. At the completion of operations, existing work shall be in a condition equal to or better than that which existed before new work started.

1.10 ON-SITE PERMITS

1.10.1 Utility Outage Requests and Utility Connection Requests

Notify the COR at least 72 hours prior to starting excavation work.

Contractor is responsible for marking and verifying all utilities not marked.

The Contractor shall verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed. But indicated in locations to be transversed by piping, ducts, and other work to be installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

Work shall be scheduled to hold outages to a minimum.

Utility outages and connections required during the prosecution of work that affect existing systems shall be arranged for at the convenience of the Government and shall be scheduled outside the regular working hours or on weekends.

COR may permit utility outages at his discretion.

Contractor shall not be entitled to additional payment for utility outages and connections required to be performed outside the regular work hours.

Requests for utility outages and connections shall be made in writing to the COR at least 10 calendar days in advance of the time required. Each request shall state the system involved, area involved, approximate duration of outage, and the nature of work involved.

1.10.2 Borrow, Excavation, Welding, and Burning Permits

ACTIVITY	SUBMISSION DATE	SUBMISSION FORM
Borrow Permits	15 calendar days prior to work	
Excavation Permits	15 calendar days prior to work	21
Welding Permits	15 calendar days prior to work	21

Permits shall be posted at a conspicuous location in the construction area.

Burning of trash or rubbish is not permitted on project site.

Any burning of trash or rubbish shall be done in strict compliance with requirements established by the authority having jurisdiction.

1.11 LOCATION OF UNDERGROUND FACILITIES

Obtain digging permits prior to start of excavation by contacting the COR 15 calendar days in advance. Scan the construction site with Ground Penetrating Radar and electromagnetic or sonic equipment, and mark the surface of the ground pier deck or paved surface where existing underground utilities or utilities encased in pier structures are discovered. Verify the elevations of existing piping, utilities,and any type of underground or encased obstruction not indicated to be specified or removed but indicated or discovered during scanning in locations to be traversed by piping, ducts, and other work to be conducted or installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

1.11.1 Notification Prior to Excavation

Notify the COR at least 15 days prior to starting excavation work. Contact

Miss Utility 48 hours prior to excavating. Contractor is responsible for marking all utilities not marked by Miss Utility.

1.12 SALVAGE MATERIAL AND EQUIPMENT

Items designated by the COR to be salvaged shall remain the property of the Government.

The salvaged property shall be segregated, itemized, delivered, and off-loaded at the Government designated storage area located within 1 miles of the construction site.

Contractor shall maintain property control records for material or equipment designated as salvage. Contractor's system of property control may be used if approved by the COR. Contractor shall be responsible for storage and protection of salvaged materials and equipment until disposition by the COR.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

APPENDIX A

FACILITY INFORMATION MODELING SCOPE OF SERVICES AND REQUIREMENTS FOR CONSTRUCTION CONTRACTOR IN A DESIGN-BUILD PROCESS

Replace Arc Jet Complex SVS Boiler

August 24, 2012

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1. INTRODUCTION

This document defines the Contractor‘s scope of work and deliverables for using Facility Information Modeling on NASA projects delivered using a design construct methodology. If attached to an Invitation For Bid, the Contractor’s response should include the below tasks and deliverables within its proposal. If attached to the Contractor's contract with NASA, the tasks and deliverables required by this document will become an integral part of the contract. Services and deliverables must comply with NASA Facility Project Requirements NPR 8820 and APR 8829.1.

1.1 Statement of Purpose

If used effectively BIM provides opportunities to improve facility quality while maintaining or reducing facility cost. In addition, BIM creates opportunities for reusing data for multiple purposes, including NASA’s operation and maintenance of its facilities. To achieve these ends, the BIM must be structured to achieve the required purposes. This document describes NASA’s requirements for use of Building Information Models (BIM) in the design and construction of its facilities.

1.2 Building Information Model

“Building Information Model” (BIM) or “Model” is a parametric, computable representation of the project design developed by the Contractor, its consultants, and any design/build subcontractors, and includes construction details developed by the Contractor and its respective consultants and subcontractors that are integrated into the model. As used in this BIM Specification, references to Building Information Model, BIM, or the Model, include the primary design model or models and all linked, related, affiliated or subsidiary models developed for design, analysis, estimating, detailing, fabrication, construction, operation or maintenance of the project, or any portion or element of the project, whether the model is prepared by Contractor or prepared by Contractor’s subcontractors or consultants.

The architects, engineers, designers and technicians involved with providing services under Contractor’s Agreement, must be trained and experienced in using BIM technology and processes. Unless BIM software is being provided by NASA, Contractor must have, or must obtain at its own cost, sufficient software licenses and computer hardware to adequately perform the services required.

1.3 BIM Competence and Responsibilities

Contractor must provide NASA with a detailed written description of the BIM experience of its key project team members. At a minimum, the key project team members include the construction project manager, the construction cost estimator, scheduling engineer, construction project engineer, and construction superintendent. In addition, Contractor must designate a BIM Manager to oversee the technical aspects of developing, managing and maintaining the BIM model. Contractor's proposal must describe the BIM experience and responsibilities of these key personnel on at least three prior projects that are similar to the current project in size and complexity. The proposal must also describe how their prior BIM experience relates to specific BIM deliverables and tasks within the Contractor's scope of work or proposal.

Contractor must have, or must obtain at its own cost, sufficient software licenses and computer hardware to adequately perform the services required.

1.4 Data Ownership and Reuse

NASA owns the BIM, the data contained within it, and all copyrights to the BIM. Contractor must arrange by contract to have the ownership and copyright to those portions of the BIM created by Contractor and its subcontractor's assigned to NASA. Contractor shall make BIM available to NASA exclusively for purposes of determining clash detection of facility systems and components, the quantity of components, calculating the surface area or volumes of materials or assemblies necessary for the completion of the project, optimum construction sequencing, material logistics, and construction equipment placement (the "Reference Uses") and Contractor transfers the BIM to NASA exclusively for Reference Uses.

1.5 Relationship of BIM Requirements to other Requirements

The BIM developed by the Contractor must satisfy the requirements of the Request for Proposal, NASA Facility Project Requirements, this BIM Specification, and any additional requirements noted in the Contract. To the greatest extent practicable, the BIM should describe the project as it will be constructed, with the exception of elements that cannot be practicably modeled because of software limitations or that are smaller than elements normally modeled on similar projects. All limitations to the extent of modeling must be identified in the BIM Execution Plan (Section 3) and agreed in writing by the NASA Contracting Officer. Those project elements that are not modeled will be constructed in accordance with supplementary design information prepared by Contractor that has been fully coordinated with the modeled

information

2. **MODEL** COMMUNICATION **AND ACCESSIBILITY**

2.1 Security

The NASA COR will advise Contractor of the security classification applicable to the BIM, including draft and related information. Contractor is responsible for maintaining the security of the BIM, including access to the BIM, in accordance with NASA regulations and guidelines. The obligation to keep the BIM secure continues throughout performance of this contract and survives termination. At the conclusion of the project, the BIM and all draft or related information must be given to NASA and any copies destroyed in a manner appropriate for the security classification applicable to the information and as required by NASA regulations.

2.2 NASA Review

The BIM must be reasonably available for NASA review and comment throughout the project. The NASA Project Manager, and others designated by the Project Manager shall be provided with secure access to the server or servers where the BIM is located and with a reasonable method for providing comments regarding the BIM.

NASA's right to review, and NASA's review of the BIM is for NASA's convenience, alone, and does not create any duty for NASA to review the BIM or to take any action upon reviewing the BIM, nor does it relieve Design/Builder of any of its responsibility for complying with the terms of its contract, including its responsibility to properly design and construct the project.

2.3 NASA Interaction

Contractor will maintain and administer the BIM and associated servers. The contractor will provide BIM access to NASA and NASA contractors as designated by the NASA Project Manager for the following purposes:

2.3.1 Commissioning

The NASA designated commissioning authority will be provided access to the BIM and associated servers. The contractor will coordinate with the commissioning authority the integration of model view definitions into the BIM.

2.3.2 Facility Management

The NASA designated facility managers will be provided access to the BIM and associated servers. The contractor will coordinate with the facility managers the integration of model view definitions and the format and content of the record BIM.

2.3.3 Reviews

The NASA Project Manager and designated reviewers will be provided access to the BIM and associated servers. The contractor will coordinate with the NASA project manager and reviewers the use of the BIM for defined NASA reviews. The contractor will enable NASA to document review comments into the BIM.

2.3.4 Export information

NASA will be provided access to the BIM and associated servers for exporting information. NASA reserves the right to utilize information exported from the BIM at any time during the contract Clash Detection and Conflict Resolution.

3. BIM FUNCTIONAL REQUIREMENTS

3.1 Models

The Contractor will provide a BIM of the following systems during design and construction. For as-built model requirements refer to Section 6 of this building information modeling scope of services and requirements for design/build document. The contractor(s) shall properly use available “intelligent objects” to embody information about the building component requirements and properties (e.g., material properties, functional information, dimensions, uniformat assembly information, etc). The following sections describe more specific information that shall be included in, but not limited to, the following models:

3.1.1 Architectural

The Contractor will provide a 3D BIM created with architectural components that embody proper object information and parametric relationships in accordance with good architectural practice. These components include, but not limited, to slabs/floors, exterior and interior walls, roofs, doors, windows, stairs, railings, elevators, finishes, ceilings,

millwork and case goods.

3.1.2 Furniture, Furnishings and Equipment (FF&E)

The Contractor will provide a 3D BIM created with architectural components that embody proper object information and parametric relationships in accordance with good architectural practice. These components include, but are not limited to, furniture, furnishings and equipment, including both Contractor furnished and Government furnished items.

3.1.3 Structural

The Contractor will provide a 3D BIM created with structural components that embody proper object information and parametric relationships in accordance with good structural engineering practice. These components include, but are not limited to, all substructure and superstructure components. The object information will include member profile and dimension information.

3.1.4 Mechanical

The Contractor will provide a 3D BIM created with mechanical components that embody proper object information and parametric relationships in accordance with good mechanical engineering practice. These components include, but are not limited to, all major mechanical equipment, cooling towers, chillers, air handling units, pumps, terminal boxes, hydrants, HVAC piping and ductwork, hangers, and other HVAC equipment. Piping bends are to be modeled for coordination with other trades.

3.1.5 Electrical

The Contractor will provide a 3D BIM created with electrical components that embody proper object information and parametric relationships in accordance with good electrical engineering practice. These components include, but are not limited to, all major electrical equipment, transformers, switchgear, generators, panel boards, lights, conduit over 2" (50.8mm) nominal O.D, hangers, cable trays, raceways and other electrical equipment. Conduit bends are to be modeled for coordination with other trades.

3.1.6 Plumbing

The Contractor will provide a 3D BIM created with plumbing components

that embody proper object information and parametric relationships in accordance with good mechanical engineering practice. These components include, but are not limited to, all major plumbing equipment, fixtures, boilers, pumps, piping over 1 1/2" (38.1 mm) nominal O.D., hangers, and other plumbing equipment. Pipe bends are to be modeled for coordination with other trades.

3.1.7 Telecommunications / Information Technology

The Contractor will provide a 3D BIM created with telecommunications and information technology components that embody proper object information and parametric relationships in accordance with good engineering practice. These components include, but are not limited to, all major equipment, MDFs, IDFs, panel boards, conduit over 2" (50.8mm) nominal O.D., hangers, cable trays, raceways and other equipment. Conduit bends are to be modeled for coordination with other trades.

3.1.8 Underground Utilities (Civil)

The Contractor will provide a 3D BIM for underground utilities created with civil components that embody proper object information and parametric relationships in accordance with good civil engineering practice. These components include all underground utilities, piping, duct banks, vaults, manholes, hand holes, location of soil borings with associated data and other civil features.

3.1.9 Site / Campus (Civil and Landscape)

The Contractor will provide 3D BIMs for site and campus design with both civil and landscape components that embody proper object information and parametric relationships in accordance with good civil engineering and landscape architecture practice. These components include, but not limited to, topographic grading, streetscape, landscape including hardscape, trees, planting stock (including roof), storm water drainage features (such as catch basins and drain inlets), exterior lighting, and other site and campus features.

3.2 Design Coherence

3.2.1 General

The Contractor must conduct and manage an adequate and thorough Clash Detection process before commencing construction so that interferences between facility components will be detected and resolved before fabrication and installation. Contractor is solely

responsible for the cost of remedying any clashes that could have been discovered during this Clash Detection process. Before commencing construction, and as indicated in any shop drawing or submittal schedule, Contractor must prepare or obtain all shop information, fabrication information, or layout information (Submittals) necessary to clash detect the Submittals against each other and against the Contract Documents. If the Submittals are not in an interoperable 3D modeled format, Contractor must model the Submittal information to allow digital clash detection.

The Contractor's BIM Manager must assemble a composite model from all of the model parts for the purpose of performing a visual check of the facility design for spatial and system coordination.

The clash detection process should uncover and address hard clashes between modeled elements and soft clashes, such as infringements into code or maintenance required clearances and necessary clearances for fireproofing, insulation or other non-modeled elements. Prior to each scheduled coordination meeting, an updated clash report must be issued by the BIM Manager to technical and engineering subcontractors.

Contractor must use coordination software for assembling the various construction models to electronically identify, collectively coordinate resolutions, and track and publish interference reports between all disciplines. The Contractor must be responsible for updating their models to reflect the coordinated resolution.

The Contractor must review the model and the clash reports in coordination meetings as required by the BEP, until all spatial and system coordination issues have been resolved. The clash report must be integrated and overlayed within the BIM.

Internal Clash Resolution – The Contractor must verify that the Subcontractors responsible for multiple scopes of work are coordinating the clashes between those scopes prior to providing those models to the Contractor's BIM Information Manager for spatial and system coordination.

Spatial Coordination Verification: Contractor to maintain verification and tracking of resolved conflicts of all discipline coordination issues.

For ease of identification during the 3D clash detection/coordination process, it is required that the following trades be represented in these assigned colors:

Trade colors for Clash Detection

Trade Name	**Color Name**	**RGB Number**
Architecture	White	255,255,255
Structural Steel	Maroon	176,48,96
Concrete	Grey75	191,191,191
HVAC Equipment:	Gold	255,215,0
HVAC Supply Duct/Diffuser	Sky Blue	50,153,204
HVAC Return Duct/Diffuser	Magenta	255,0,255
HVAC Pipe	Gold	255,215,0
Electrical Equipment	Dark Yellow	205,205,0
Electrical Conduits	Light Yellow	255,255,224
Communication Conduit	Light Blue	205,127,50
Electrical Cable Tray	Dark Orange	255,140,0
Electrical Lighting	Yellow	255,255,0
Plumbing Water	Cyan	209,238,238
*Process Piping – Auxiliary Heating Water Return (AWXR)	11,Dark Pink	255 127, 127
*Process Piping – Blowdown (BD)	21,Peach	255, 159, 127
*Process Piping – Boiler Feedwater (BFW)	101,Kelly Green	82, 165, 103
*Process Piping – Chemical Feed (CF)	8,Medium Grey	128, 128, 128
*Process Piping – Feedwater Drain (FWD)	101,Bright Green	127, 255, 159
*Process Piping – Medium Pressure Gas (G)	211,Bright Magenta	255, 127, 255
*Process Piping – High Press. Steam (HPS)	51, Faded Yellow	255, 255, 127

*Process Piping – Instrument Air (IA)	161,Lavender	127, 159, 255
*Process Piping – Low Press. Steam (LPS)	141,Faded Cyan	127, 223, 255
*Process Piping – Soft Cold Water (SCW)	31,Sienna	255, 191, 127
*Process Piping – Vent (A)	161,Lavender	127, 159, 255
Plumbing Sewer	Magenta	255,0,255
Plumbing Storm Drain	Green	0,255,0
Fire Protection	Red	255,0,0
Pneumatic Tube	Dark Green	47,79,47
Equipment	Light Green	152,251,152
Gas	Light Green	152,251,152
Security Systems	Orange	255,165,0
Fire Alarm	Fuchsia	255,0,255

3.2.2 Minimum Requirements for Spatial Coordination and Clash Detection

Architecture + Structural: Below-grade spaces, proposed floor plates with major penetrations, floor-to-floor heights, beam clearances, heavy utilities locations, floor loads, core, and vertical shafts, beam depths and required clearances, slab thickness, columns, column caps, and structural bracing including seismic. Provide adequate space for construction and maintenance access to structural elements, facility equipment, and distribution systems.

MEPF (internal): Clash detection for MEPF elements.

Architecture + MEPF: Structural and space elements, flow and isolation requirements, proposed functional area configurations, floor-to-floor heights, fire containment, vertical and horizontal transportation. Possible NASA defined future expansions must be considered and must be clash-free.

MEPF/HVAC + Architecture, Structure, and Process Piping: Main distribution and collection systems, configurations and sizes for piping, duct, conduit, power

wiring, blowers; diffusers; large compressors; intakes, large compressors, hangers. Clearance reservations for equipment maintenance filter removal, and equipment removal and replacement must be modeled with the equipment, and sign-off on the adequacy of the space reservations must be obtained from NASA.

Vertical shafts will be reviewed to ensure that adequate space has been allocated for all of the vertical mechanical systems. All of the shafts are to line up floor to floor.

Architecture/HVAC + Interiors: Merges must include ductwork and piping + ceilings and FF&E + HVAC.

General Model Quality Checking: All walls must be properly joined to prevent "space leaks" in areas defined by enclosing walls. Bounding boxes must not conflict.

Security setbacks + structure + site: Include line of site coherence check for allowance of security zone as defined by NASA security criteria.

Accessibility Compliance: Wheelchair pathways and clearances + structure + MEPF components. These components must include plumbing fixtures.

3.3 Code Review

The Contractor will use the BIM Authoring software or model checking software to validate the design is in compliance with stated building code requirements.

3.4 Construction Document Drawings

Contractor will produce construction document drawings utilizing IFC compliant BIM Authoring software. All drawing information, including 2D plans, elevations, sections, schedules and details, needed to describe the design intent for subcontractor bidding will be graphically or alphanumerically included in and derived from models created in the BIM Authoring software. All 2D drawings must comply with the graphic standards as referenced in NASA Facility Project Requirements, NPR 8820, and any Center specific standards.

3.5 Contract BIM Model During Construction

3.5.1 Scheduling

Reviews of the BIM during construction must be part of the required construction meetings. The BIM reviews must be included in the Contractor's construction

meeting agenda. The BIM reviews must include clash detection, model view definitions and facility management requirements integration.

The BIM must be linked to Contractor's digital critical path method ("CPM") approved baseline construction schedule and subsequent CPM schedule updates to allow simulation of the construction phasing and sequencing.

Impacts to the schedule from change orders, which create modifications to the BIM, will require, through the link between the BIM and the schedule, the contractor to identify the schedule impacts in the BIM.

At a minimum, the digital schedule should link to the following modeled systems:

3.5.2 Structural: All structural framing components including foundations, , columns, roof decks and supports;

3.5.3 Interior partitions: Main plumbing walls and wall assemblies;

3.5.4 Mechanical systems: Main duct work and equipment (separated by floors);

3.5.5 Roof systems: Roof assemblies, major roof mounted equipment, openings;

3.5.6 Plumbing: Main connection lines from site, main plumbing lines;

3.5.7 Sitework: Excavation work, footings, foundations, on-grade slab; and

3.5.8 Site Logistics: Site layout, safety access; material storage; coordination.

3.6 Construction Management

3.6.1 Submittals

In addition to any other requirements of the Contract Documents, submittals should be provided as:

3.6.1.1 Manufacturer's model elements that are interoperable with the BIM and provided by the manufacturer or vendor of materials, equipment or systems;

3.6.1.2 Custom created model elements prepared by the Contractor or its subcontractors that are interoperable with the BIM and model portions of the project, specific

installations or details or equipment;

3.6.1.3 Fabrication or detail models that are prepared by Contractor or its subcontractors. These fabrication or detail models must be in software that is interoperable with the BIM or that can be compared to the BIM for clash detection or other purposes through the use of viewing software that is interoperable with the BIM and the fabrication or detail modeling software;

3.6.1.4 Contractor must submit for review an analysis report detailing the BIM coordination and clash detection activities. The report must include:

- Coordination and clash detection between the contract document design models and Contractor created models;
- Coordination and clash detection between all Contractor created models; and
- Identification of coordination issues and clashes

3.6.2 Change Orders

Design changes reflected in Change Orders approved by NASA must be promptly incorporated into the BIM such that the BIM reflects the current approved design. Design changes during construction must be clash-detected to determine the extent of impact due to the changed design prior to approval of the Change Order.

3.6.3 Commissioning

In addition to any other requirements for commissioning Contractor must:

- Coordinate with the commissioning authority throughout construction to update the BIM with model view definitions of the model elements.
- Provide the commissioning authority access to the BIM during construction to review and export out model information.

3.7 Record BIM

The BIM must be updated continuously throughout the construction process and must include all addenda, approved change orders, field orders, clarifications, Request for Information (RFI) responses and as-built conditions. The Record BIM includes the BIM at a Level of Detail 500 and includes a description of the relationship of each model in the Record

BIM to the others. Contractor may reference the AIA Document E202 – 2008 for Level of Detail 500 description. In addition, the Record BIM must be accompanied by the final versions of all fabrication and detailing models prepared by Contractor and its subcontractors. All models must be provided in native file format with a description of the software used to create the model (software manufacturer, software name, version number, and operating system used for the software.

4. BIM EXECUTION PLAN (BEP)

Within 30 days after execution of the Contract, Contractor will prepare a BIM Execution Plan (BEP) confirming the intended uses of the BIM during both the design and construction phases of the project, describing the communication paths, the model structure, the Level of Detail of the modeled elements at each contractual milestone or deliverable, and the BIM process design. The BEP will be provided to NASA for its review and approval. Once approved, the BEP cannot be modified without NASA's written approval.

The BEP must, at a minimum, contain the following elements:

4.1 BIM Staffing Plan

Contractor must identify for itself and each of its subcontractors and consultants, the persons that within their organizations responsible for managing the BIM, or portion of the BIM. Where an organization is responsible for multiple disciplines, or where the project is divided into sections or phases, the BIM Staffing Plan should include the persons responsible for the discipline, section or phase. For each person identified, the BIM Staffing Plan should include the person's:

- Name;
- Title;
- Contact Information (location, primary phone number, mobile phone number, and email address);
- Description of the duration and extent of the person’s experience with the BIM software the Contractor proposes to use;
- Identification and description of prior projects where the person used BIM software and the extent it was used on that project;
- Role (i.e., BIM structural design lead; BIM mechanical design leader, etc.); and
- Anticipated time devoted to the project in hours per week. If the level of activity will vary throughout the project, the staffing plan should be delivered as a schedule. This

may be depicted on a monthly schedule basis where the level of activity will vary during the project.

4.2 Security Plan

Contractor must prepare a Security Plan that describes the procedures and safeguards used to preserve the confidentiality and integrity of the BIM and to demonstrate compliance with NASA requirements for data security and integrity.

4.3 Model Progression Matrix

The BEP must contain a model progression matrix substantially similar to the Model Progression Specification spreadsheet published by American Institute of Architects, California Council or the Model Element Table, Section 4.2 of American Institute of Architect's Document AIA E-202. The columns of the matrix should be modified to match Contractor's submittal schedule and the Level of Detail (LOD) shown must comply with Uniformat II, Level 3 model components and should include user level sub-categorization, (Uniformat Levels 4 & 5 if necessary to provide appropriately defined LOD and model component author responsibility).

4.4 BIM Process Design

Contractor must lead a workshop that includes Contractor's staff, Contractor's subcontractors, and NASA staff. The purpose of the workshop is to develop process diagrams documenting BIM information exchange and BIM workflow. At a minimum, the process mapping should include a process map of the overall BIM processes and individual detailed maps documenting the information and workflow applicable to specific BIM uses. At the conclusion of the workshop, the Contractor must prepare the process overview and detailed BIM process maps and distribute them to the workshop participants. Examples of the BIM process design maps and supporting worksheets are contained in the BIM Project Execution Planning Guide, published by the Penn State Computer Integrated Construction Research Program.

4.5 Schedule

Contractor must prepare a schedule for BIM deliverables tied to the Model Progression Matrix. The schedule must include all BIM tasks of Contractor's subcontractors, the schedule of clash detection and resolution meetings, and appropriate review time by NASA or other governmental agencies that will comment or render decisions regarding the project construction. The schedule must be submitted to NASA for review as directed by the contract

documents.

4.6 Model Structure

4.6.1 File Naming Structure

File names for models should be formatted as project number-facility number/site description-discipline.file extension. (Example: ARCH-1111-BL001.rvt) File name prefixes by discipline are listed in the table below.

Architectural Model	PROJ#-SITE_DESC-ARCH
Civil Model	PROJ#-SITE_DESC-CIVIL
Mechanical Model	PROJ#-SITE_DESC-MECH
Plumbing Model	PROJ#-SITE_DESC-PLUMB
Electrical Model	PROJ#-SITE_DESC-ELEC
Structural Model	PROJ#-SITE_DESC-STRUC
Telecommunications/Information Technology Model	PROJ#-SITE_DESC-IT
Coordination Model	PROJ#-SITE_DESC-COORD
Construction Model	CONST
Other Model Types as Required	PROJ#-SITE_DESC-AsReq'd

4.6.2 Model Structure and Division of Modeled Information

In most instances, the BIM will consist of a series of related models that depict information relevant to specific disciplines or uses. Moreover, a specific discipline model or use model may be organized into separate floors, sections, divisions or files. The BEP must describe the organization of the model files, explaining how each file and model is separated, the file naming conventions that will be used for each file type, the relationship of files to each other, and the process that Contractor will use to ensure that all of the models remain current and consistent.

4.6.3 Measurement and Coordinate Systems

The measurement and coordinate systems are to be confirmed and

documented in the BEP for this project. The Contractor must provide the following

All measurements must be in units of measurement required by standards applicable to the specific NASA center.

4.7 Software and Operating Systems

The BEP must list the BIM software and computer operating system or systems to be used by Contractor and its subcontractors for this project. The software and operating systems should be identified by vendor, product name, version identifier, build identifier, patch number, and data architecture (32bit/64bit). Listed software, and listed operating systems, can not be changed or upgraded without NASA's written approval, which will not be granted unless Contractor demonstrates that the change or upgrade will not affect the ability to use existing BIM information or to reliably and accurately exchange BIM information with other listed software.

4.8 Electronic Communication Procedures

4.8.1 File Access and Archiving

The BEP must specify:

- The physical and logical locations of BIM files and related electronic information;
- The protocols for archiving and disaster recovery;
- The protocols for user access and file permissions;
- The directory/subdirectory/file structure used to organize the BIM files and related electronic information;
- The internet address and directory structure for a secure web site, internet accessible project manager, or web portal used to store and access BIM files; and
- Maintenance of BIM as-built information during construction

4.8.2 Electronic file formats and use.

The BEP must specify:

- The types of digital information that will be transmitted between project participants;
- The acceptable methods of transmission; and

- The acceptable file format(s) to be used for the type of digital information.

4.8.3 Contractor Information Manager(s)

The BEP must identify and provide contact information for the persons responsible for managing and executing the responsibilities of this section.

4.9 Change Management

The BEP should specify the process for integrating submittals, change orders, RFI responses, clarifications and similar construction phase information into the BIM. The process should describe:

- Who is authorized to integrate the construction level information into the BIM;
- How construction level information will be coordinated and clash detected with the existing BIM information;
- How changes to the BIM will be logged; and
- How construction level information will be identified to distinguish it from Design BIM information.

4.10 Construction Management

The Execution Plan must outline the strategy and schedule for utilizing BIM Technology to execute construction related activities and project coordination. The Execution Plan must address the following:

- Constructability analysis with BIM
- Animation/graphic showing installed major facility equipment space clearance reservations for operations, repair, maintenance, and replacement
- Proposed trade coordination strategy (clash detection)
- Proposed use of digital fabrication
- Updating as-built conditions in Record BIM
- Utilization of 4D scheduling and construction sequencing technology
- List of subcontractors using digital fabrication
- Proposed BIM Software to be used by the builder and fabrication modelers
- Strategy to assure all trade information is modeled and coordinated
- Proposed subcontractor BIM workshops and training integrated into project schedule
- Integration of construction changes and commissioning data into BIM

- Strategy for COBie2 integration and submittals

4.11 Facility Management

The BEP must specify a workflow to identify model elements that are significant for operations and maintenance of the facility and to map data structures from NASA's Computerized Maintenance Management System (CMMS) and Computer Aided Facility Management (CAFM) to Systems attributes of the identified model elements. Where the CMMS and Facility Management System (FMS) data structure does not have a comparable attribute in a modeled element, the BEP should define an additional custom model element attribute to provide congruent mapping to the CMMS data structure.

The BEP should specify a workflow for transferring FM data from the BIM to the CMMS either directly or through middleware that manages the interchange of information between the Record Model and the CMMS.

5. INTEROPERABILITY

NASA has selected BIM software that is adequate for Contractor's tasks. Moreover, Contractor must demonstrate that compatible software used by it and its subcontractors can exchange BIM information reliably and accurately and can read and export BIM information into open source file formats to the extent required in Section 5.2. Contractor must demonstrate, through the technical specification of the chosen compatible software, that it can meet the required functional requirements of the proposed software listed below.

5.1 BIM Software

BIM software for NASA projects must support intelligent objects and parametric relationships. The software must comply with current industry interoperability standards and be usable in a collaborative environment. All software platforms used for NASA projects must be compliant with:

- The most current version of Industry Foundation Classes (IFC) file format; and
- Commercially available collaboration software that provides interoperability between the different software applications (see below).

Additional software not listed below may be found on the Facility SMART Alliance web site, http://www.facilitysmartalliance.org/.

TYPE (These are general categories. Listed software can be used for more than one "Type.")	**SOFTWARE** (no order of preference)
Authoring – Design (Architecture, Structural)	Revit Architecture, Revit Structure
Authoring - MEPF (Engineering & Construction)	AutoCAD Plant 3D
Authoring – Civil	Autodesk Civil 3D
Coordination (clash detection)	NavisWorks Manage
4D Scheduling	MS Project

5.2 Open Source File Formats/Open Standards

5.2.1 Statement of Principal

To ensure the life-cycle use of NASA facility information, NASA requires that information supporting common industry deliverables be provided in existing open standards, where available. For those contract deliverables whose open standard formats have not yet been finalized, the deliverable must be provided in a mutually agreed upon format that allows the re-use of facility information outside the context of the proprietary BIM software. The formats used will be specified in the BIM Execution Plan and must include, at a minimum, the following standards:

5.2.2 Current Version IFC Model View Definition (MVD) Formats:

Coordination---This format will be required for all deliverables needed to demonstrate the coordination of all disciplines prior to construction. In addition to the Coordination View file(s), where required, the Contractor will provide a report highlighting automatically detected (hard and soft) collisions and identifying those collisions that require further work by the Contractor.

5.2.3 Portable Document Format:

Non-modeled information authored directly by the Contractor must be transformed to PDF to allow searching for and selection of text within the document. Documents authored by others, but used by the Contractor such as manufacturer product data sheets, must be provided the format made available by the manufacturer or scanned as image-based PDF documents.

5.2.4 GBxml

At a minimum, Architectural, Mechanical and Electrical BIM software must support accurate and reliable data export to GBxml for environmental analysis, optimization, and sustainability classifications, such as LEED, Green Globes and Energy Star.

5.2.5 COBie2

BIM authoring software must support data export and import from the COBie2 table databases.

5.2.6 FM/BAS Integration Export

NASA currently uses Maximo by IBM as its primary Computerized Maintenance Management System (CMMS). The Record BIM must map Maximo input fields as required by this Specification to allow CMMS data export from the Record BIM into Maximo. Mapping should follow the guidelines of USACE Engineer Research and Development Center, *COBie2 Data Import/Export Interoperability with the MAXIMO Computerized Maintenance Management System*, November 2008.

6. RECORD MODEL

6.1.1 Objectives

To create a BIM(s) that contains the actual population of architectural, structural, mechanical, electrical, plumbing, and civil objects for facility services such as, HVAC, Data/Communications, Security, and Lighting that may be utilized for facility design, construction, and operation.

To populate the critical mechanical, electrical, plumbing, and civil objects with the appropriate performance requirements and as-built information. The object attribute information that is captured will be used throughout the facility lifecycle and potentially integrated into NASA's ArcGIS system as implemented at each NASA Center.

To create an accurate current-condition record of the existing facility conditions.

6.2 Requirements

Contractor must update the BIM to accurately reflect all design and construction changes from the final pre-construction DBIM submitted to NASA.

Contractor must create a Record Facility Information Model that accurately reflects “as-built” conditions for all facility systems including but not limited to, architectural, civil, structural, mechanical, life safety, and electrical systems.

The Contractor must model the following:

- Underground Utilities (within facility footprint and 15’ beyond its perimeter);
- Architectural models;
- Structural models;
- Civil models:
    - All underground utilities
    - Topography
    - Hardscape (parking, pavement, sidewalks, curbs)
- Mechanical elements limited to:
    - All fixed mechanical ducts;
        - Calculation information and sustaining information tied into models views
        - Space – Zone/Circulation Information
    - All fixtures and equipment (Manufacturer, Model size, and Weight);
    - Equipment performance information (Input/Output);
    - All piping, 3/4” or greater and terminations;
- Electrical elements limited to:
    - Electrical conduit 3/4” (19.05mm)or greater and terminations;
    - All fixtures and equipment (Manufacturer, Model size, and Weight);
    - Equipment performance information (Input/Output);
    - Power distribution (Panels and Circuits);
    - Lighting
- Plumbing elements limited to:
    - Plumbing piping 1/4” (6.35mm) or greater and terminations;
    - All fixtures and equipment (Manufacturer, Model size, and Weight);
- Telecommunications/Data Communications limited to:
    - Conduit ¾” (19.05mm) or greater and terminations;

- All fixtures and equipment (Manufacturer, Model size, and Weight);

The following must be defined for all systems:

- Materials;
- Finishes;
- All electrical circuiting;
- Cable trays and raceways;
- Tags;
- Labels;
- All Warranty information tied to the model objects and presented in views;
- Product Data / Cut Sheets tied to the objects; and
- Maintenance Schedules and operations data

6.3 Facility Management Information

Record Model must be consistent with the COBie2 Model View Definition published by the National Institute of Facility Science in the Whole Facility Design Guide.

The Contractor will assist NASA in the integration of the project BIM into the NASA computerized maintenance management system (CMMS). This Contractor's effort will consist of collecting, validating, updating, and exporting design, construction and commissioning data for NASA's use, and if required by the contract, entering the information into NASA's CMMS.

The Contractor must prepare the BIM at each phase with the following defined information

6.3.1 Design Phase:

- Facility and Floors are defined
- Spaces should be classified using OmniClass and Net
- Area is provided (Gross Area is generated by Authoring
- Software)
- Zones should have Categories assigned
- Types should have Name, Category (OmniClass),

- Description, AssetType
- Components should have Name, Description, Type and
- Space
- Systems should have Name, Category (OmniClass),
- Components

6.3.2 Construction Phase:

- Type information updated by providing manufacturer, model number, warranty information (parts and labor and duration), replacement cost;
- Component information updated by providing serial number, installation date, warranty start date, and optionally tag number or barcode. Installation date for major equipment will be the finish date of the corresponding schedule activity;
- Spare parts provided for types; and
- Attributes provided for types and components.

6.3.3 Commissioning Phase:

- Documents assigned (uploaded) to corresponding BIM objects (types, components, spaces, facility); and
- Attributes corrected based on real measurements.

7. MODELING REQUIREMENTS

7.1 General

BIM will be used for all facility systems design, development, analysis, and fabrication including but not limited to architectural, structural, mechanical, electrical, plumbing, fire suppression, civil and landscape.

Model objects must contain IFC parameters and associated data applicable to facility system requirements. These elements must support the analytic process include size, material, location, mounting heights, and system information where applicable. As an example, a light fixture may contain several parameters such as energy output requirements, user illumination levels, make, model, manufacturer, and bulb life. Elements, objects and equipment must be tagged with unique identifiers (GUIDs).

7.2 Types of Model Elements

Model elements must be derived from the following sources:

Manufacturer's Model Elements - elements created by and acquired from manufacturers often have more information than is prudent to keep in the BIM model; the appropriate level of detail should be retained for the design element. However, embedded performance data must remain for analysis and specification purposes.

Custom Created Model Elements – custom model elements that are created must utilize appropriate BIM Authoring tool templates to create custom elements. Custom models elements need to be assigned as a part of a family or group with parametric model view definition information.

Fabrication Model Elements – elements created by the construction sub-contract fabricators must have embedded model view definition information required by the commissioning authority for transfer from the BIM to the facility management software. The fabrication model elements must be parametric model objects.

7.3 Model Geographical Location

The spatial coordination (coordinates) of the master BIM file will be set at the beginning of the project. Once established, spatial coordinates will only be changed by mutual consent of the Contractor and the NASA project manager, with the matter recorded in the meeting minutes and the BIM Execution Plan. Once the design coordinate system is agreed upon, any model(s) of existing buildings relevant to the project will be converted into the coordinate system used for each designed building.

As is standard practice, NASA requires that a building within a BIM file include a geo-reference to accurately locate that building within the site and to give it a physical location context at larger scales. The Contractor Information Manager will geo-reference site plans and building models for site layout surveying and future GIS use in accordance with the State Plane Coordinate system where the project is located. The BIM file point will be located at the SW corner of the structural grid.

7.4 **POINTS** of Reference

The Contractor Information Manager must provide a 3D grid for incorporation into the spatial coordination model. This will provide the viewer with a quick point of reference when navigating through the model. Room information must also be incorporated.

Space information imported from the NASA project program requirements will be the source for space creation in BIM.

Areas of four square feet or greater will be tracked and identified by name, even if those spaces are not listed in the program narrative.

Spatial data will be generated and associated with bounding elements (walls, doors, windows, floors, columns, ceilings).

The Assignable Areas Square Footage (ASF), Non-Assignable Areas Square Footage (NaSF), and Gross Square Footage (GSF) will be modeled for each functional space, using the appropriate space/object BIM tool to capture and carry the information. Spaces will be represented and broken down into functional spaces even though they may be parts of a larger physical space. A physical space may contain several areas that are treated individually in the spatial program. If two areas have different functional space classifications, even though they are within the same physical space, they will be modeled as two separate spaces.

Space/area schedules and diagrams must be dynamically updated from the model geometry.

Spatial Requirements must be validated through reports generated from the BIM.

7.5 Requirements for Modeling Space

Spatial data must be generated and associated with bounding elements (walls, doors, windows, floors, columns, ceilings).

7.6 Space Naming and Coding

Contractors space naming and coding must use the following format:

- Facility Name;
- Facility Number – NASA Center Facility Numbering System;
- Floor (and/or Level);
- Department;
- Sub-department;
- Space Name – English Name & Abbreviation;
- Room Number – NASA Wayfinding Room Number;
- Room Number – Construction Document Number (used on large complex projects

for builder use);

7.7 Requirements for Record BIM and Facility Management Information

Contractor must incorporate model view definition information into the BIM as defined by COBie2. The Contractor must utilize the Omniclass™ Construction Classification System (OCCS) for the classification structure of the data

7.8 Contractor BIM Deliverables

7.8.1 Models

The Contractor will ensure that the models remain current throughout design and construction of the project. During design and construction the Contractor will be responsible for providing a fully coordinated and assembled model compatible with the original software authoring that is consistent with the:

- Native file format(s) of Models (version as agreed in BIM Execution Plan);
- IFC file format (version as agreed in BIM Execution Plan); and
- Collaboration software format (Navisworks Manage or equal or (version as agreed in BIM Execution Plan) for fully coordinated and assembled BIM.

The Contractor will provide record model(s) for all facility systems. The model(s) must be fully coordinated and the required instructions on file/folder setup must also be included:

- Native file formats of the final consolidated record model(s) for facility systems used in the multi-discipline coordination process (version as agreed in BIM Management Plan); and
- IFC file format of the consolidated facility systems models (version as agreed in BIM Management Plan).

7.8.2 Data Deliverables

Contractor must provide facility management data, model view definitions, in COBie2 format.

7.8.3 2D Deliverables

Contractor's 2D deliverables must be provide in:.

- In PDF format with fully bookmarked pages, where not prepared or maintained in CAD formats; or
- DWG format meeting NASA requirements.
- All 2D drawings must comply with the graphic standards as referenced in NASA Facility Project Requirements, NPR 8820

If the contract requires Contractor to design portions of the project and if, for the portion designed by Contractor will be reviewed by inspection or permitting agencies, Contractor must produce printed drawings from the model, signed and sealed by California licensed professional architects and engineers, as required by the reviewing or permitting agency.

7.8.4 Digital Deliverables

All digital deliverables are to be submitted on DVD or provided electronically through a secure website or other electronic portal with the data clearly organized and software version(s) labeled.

8. WAIVERS OF SPECIFIC REQUIREMENTS

If a requirement contained in this document can not be achieved, or can not be achieved at a cost commensurate with the value of the requirement, Contractor may request, in writing, that the requirement be withdrawn or modified. The request must certify that Contractor has diligently attempted to meet the requirement, that the requirement can not reasonably be met, and that alternative approaches meet the intent of the requirement. The request must be supported by evidence of Contractor's research and documentation that the alternative approach meets the function and interoperability requirements of this document. NASA, in its sole discretion, may waive requirements found to be currently unachievable or not commercially practicable. All waiver requests must be in writing and signed by the NASA Contracting Officer.

9. ABBREVIATIONS LIST

ADA	Americans with Disabilities Act
BEP	BIM Execution Plan
BIM	Facility Information Model (also Modeling or Management)

COBie2	Construction Operation Facility Information Exchange
DBIM	Design Facility Information Model
FM/BAS	Facility Management / Facility Automation System
FF&E	Furniture, Furnishings, & Equipment
GBxml	Green Facility XML
GSA	General Services Administrations
GUID	Globally Unique Identifier
HVAC	Heating, Ventilation, and Air-Conditioning
IFC	Industry Foundation Classes
LOD	Level of Detail
MEPF	Mechanical, Electrical, Plumbing, Fire Protection
NASA	National Aeronautics and Space Administration

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SECTION 01 14 00

WORK RESTRICTIONS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for work and site restrictions.

1.2 WORKING DAYS DEFINITION

In all sections of these specifications the term "working days" shall refer to the Government's working days: 5 days per week excluding holidays.

1.3 CONTRACTOR ACCESS AND USE OF PREMISES

1.3.1 Activity Regulations

Permission to interrupt any Activity roads, and/or utility service shall be requested in writing a minimum of 10 working days prior to the desited date of interruption.

Ensure that Contractor personnel employed on the Activity become familiar with and obey Activity regulations including safety, fire, traffic and security regulations. Keep within the limits of the work and avenues of ingress and egress. Wear hard hats in designated areas. Do not enter any restricted areas unless required to do so and until cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification. All truck and heavy equipment to be used on the project shall use the Truck and Heavy Equipment Route shown on Drawing No A331-1102-G003.

1.3.2 Entry to Radiologically Controlled Areas

Contractor personnel shall not, under any circumstances, enter a radiologically controlled area or cross any posted radiological boundary. This paragraph applies to all phases of contract work. Radiation areas are posted with signs consistent with OSHA requirements. Ensure that employees are familiar with the radiation signs and symbols.

Should contract workers encounter radiological postings and/or boundaries which appear to limit their ability to access or carry out their intended work, they shall notify their contract administrator for resolution of the problem.

1.3.2.1 Radioactive Materials and Equipment

All testing equipment, containing a radioactive source, shall be operated in accordance with an approved radioactive equipment plan. This plan shall be submitted to the COR and approved by the Radiation Officer prior to bringing the equipment onsite. This plan shall include:

a. The name and type of equipment.

b. The type and size of radiation source.

c. The dates and locations of the equipment's usage.

d. The radiological controls that the Contractor will use while operating the equipment.

A different radioactive equipment plan will be required for each different type of equipment, type of radioactive source, or size of radioactive source. A data sheet of for each piece of new radioactive equipment shall be submitted to the COR to forward to the Government's Radiation Safety Officer. The data sheet shall contain the following information:

a. Name of equipment.

b. Name and address of equipment manufacturer.

c. Type and size of radiation source.

d. The location of the installed radioactive equipment (i.e. building no., floor, code/shop area).

1.3.3 Working Hours

Regular working hours shall consist of a period established by the COR, between 7 a.m. and 5:00 p.m., Monday through Friday, excluding Government holidays.

1.3.4 Work Outside Regular Hours

Work outside regular working hours requires COR approval. Make application 10 working days prior to such work to allow arrangements to be made by the Government for inspecting the work in progress, giving the specific dates, hours, location, type of work to be performed, contract number and project title. Based on the justification provided, the COR may approve work outside regular hours. During periods of darkness, the different parts of the work shall be lighted in a manner approved by the COR.

1.3.5 Occupied and Existing Buildings

Provide temporary closures as required to maintain security as directed by the COR.

Provide dust covers or protective enclosures to protect existing work that remains and Government material during the construction period.

Relocate movable furniture away from the Contractor's working area as required to perform the work, protect the furniture, and replace the furniture in its original location upon completion of the work. Leave attached equipment in place, and protect it against damage.

1.3.6 Utility Cutovers and Interruptions

a. Make utility cutovers and interruptions after normal working hours or on Saturdays, Sundays, and Government holidays unless otherwise approved by the COR. Conform to procedures required in the paragraph "Work Outside Regular Hours."

b. Ensure that new utility lines are complete, except for the connection, before interrupting existing service.

c. Interruption to water, sanitary sewer, storm sewer, telephone service, electric service, air conditioning, heating, fire alarm, compressed air, and shall be considered utility cutovers pursuant to the paragraph entitled "Work Outside Regular Hours."

d. Utility power outages and building-wide shutdowns shall require 15 working days advanced written notice to the COR.

1.4 SECURITY REQUIREMENTS

1.4.1 Employment Restrictions

All personnel who perform any work on this contract must be either a U.S. citizen or a permanent resident alien.

1.4.2 Contractor Regulations

a. For contracts with a duration of longer than 90 days, the Contractor's Project Manager and Superintendent shall apply for a PIV Badge (a.k.a., a "hard badge") within 10 working days of the Contract Award date.

b. The Contractor shall submit a Temporary Badge Request to the COR for any worker scheduled to come on-site at lest two working days prior to the work scheduled.

c. Employees shall wear and display the badge in the chest area at all times while entering, remaining in, and exiting Ames and each badge shall be used only by the specific individual named on the badge.

d. Maintain strict accountability over identification badges and passes issued by the Pass and ID office. Immediately report to the Pass and ID Office, any badges/passes missing or lost and the circumstances. Return badges/passes to the COR immediately upon termination of any employee, expiration, completion of contract, or when no longer required. The COR will ensure that all badges/passes are returned and forwarded to the Visitors Office.

e. Restrict hours of work to 7:00 a.m. - 5:00 p.m. Monday through Friday, work days only. When operational needs require scheduling of work after 5:00 p.m. (Monday through Friday) or on weekends and holidays, provide written notification at least 10 working days in advance to the COR. Such notifications will include specific dates, hours of work, location of work, type of work to be performed, contract number and project title.

f. Restore all traffic/parking/security signs and markings, including space numbers, designations, and lines, to their original form if such signs/markings are defaced or deleted during construction/repair.

g. Be responsible for control and security of Contractor-owned equipment and materials at the work site. Report immediately, missing/lost/stolen property to the Ames Police Department (phone 650/604-5416) as each case occurs.

h. Ensure that no material is stacked within 10 feet of the perimeter. Remove from the work site, or secure ladders or other such equipment which could be used to climb the perimeter fence. Ensure that no vehicles are parked within 10 feet of the perimeter.

i. Provide written notification to the COR 10 working days prior to actual start of work to allow for notification of the appropriate departments, offices, and shops of the impact resulting from the contract work. Such notifications will include specific details such as work schedules (including actual start date for entry) and impact.

j. Ensure that no opening in the roof/walls/windows/fence of the building exist at the end of the work day and do not exist where penetration is possible during non-working hours. If the building cannot be secured at the end of the work day, coordinate action with the Contracting Office to notify the cognizant code to arrange for a security watch by their personnel.

k. Five working days prior to working in a restricted area, contact the COR to make arrangements for a security guard or other measures required to meet all security requirements. Cost of security guard will be charged to the Contractor.

l. The Contractor must have a representative on-site during all work performed under the contract to maintain security, safety, and quality control requirements.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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SECTION 01 20 00.00 20

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for payment instruction paragraphs required for use in all projects.

1.2 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Schedule of Values

1.3 SCHEDULE OF VALUES

1.3.1 Data Required

Within 10 working days of notice to proceed, prepare and deliver to the COR a Schedule of Values as directed by the COR. Provide a detailed breakdown of the contract price, giving quantities for each of the various kinds of work, unit prices, and extended prices. Costs shall be summarized and totals provided for each construction category.

1.3.2 Schedule Instructions

Payments will not be made until the Schedule of Values has been submitted to and accepted by the COR. Identify the cost for site work, and include incidental work to the 5 ft line. Identify costs for the building(s), and include work out to the 5 ft line. Work out to the 5 ft line shall include construction encompassed within a theoretical line 5 ft from the face of exterior walls and shall include attendant construction, such as pad mounted HVAC cooling equipment, cooling towers, and transformers placed beyond the 5 ft line.

1.3.3 Design Build Services

Design build services shall be no more than 10% of the total contract value on the schedule of values. Any increase beyond 10% shall require justification and is at the discretion of the COR.

1.3.4 Mobilization and Demobilization Costs

The schedule of values shall include reasonable mobilization and demobilization costs. The value of demobilization shall be at least 50% of the mobilization cost.

1.4 CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT

1.4.1 Final Invoice

a. A final invoice shall be accompanied by the Contractor's Final Release. If the Contractor is incorporated, the Final Release shall contain the corporate seal. An officer of the corporation shall sign and the corporate secretary shall certify the Final Release.

b. For final invoices being submitted via NSSC, the original Contractor's Final Release Form must be provided directly to the respective COR prior to submission of the final invoice. Once receipt of the original Final Release Form has been confirmed by the COR, the Contractor shall then submit final invoice and attach a copy of the Final Release Form.

c. Final invoices not accompanied by the Contractor's Final Release will be considered incomplete and will be returned to the Contractor.

1.5 PAYMENTS TO THE CONTRACTOR

Payments will be made on submission of itemized requests by the Contractor which comply with the requirements of this section, and will be subject to reduction for overpayments or increase for underpayments made on previous payments to the Contractor.

1.5.1 Payment for Work

The Government shall only accept invoices for work in place unless specially authorized by the Government elsewhere.

1.5.2 Obligation of Government Payments

The obligation of the Government to make payments required under the provisions of this contract will, at the discretion of the COR, be subject to reductions and/or suspensions permitted under the FAR and agency regulations including the following in accordance with "FAR 32.503-6:

a. Reasonable deductions due to defects in material or workmanship;

b. Claims which the Government may have against the Contractor under or in connection with this contract;

c. Unless otherwise adjusted, repayment to the Government upon demand for overpayments made to the Contractor; and

d. Failure to provide up to date record drawings not current as stated in Contract Clause "FAC 5252.236-9310, Record Drawings."

1.5.3 Payment for Onsite and Offsite Materials

Progress payments may be made to the contractor for materials delivered on the site, for materials stored off construction sites, or materials that are in transit to the construction sites under the following conditions:

a. FAR 52.232-5(b) Payments Under Fixed Price Construction Contracts.

b. Materials delivered on the site but not installed, including completed preparatory work, and off-site materials to be considered for progress payment shall be major high cost, long lead, special order, or

specialty items, not susceptible to deterioration or physical damage in storage or in transit to the construction site. Provide inspection or testing reports and/or documentation showing contract compliance. Materials not acceptable for payment include consumable materials such as nails, fasteners, conduits, gypsum board, glass, insulation, and wall coverings.

c. Materials to be considered for progress payment prior to installation shall be specifically and separately identified in the Contractor's estimates of work submitted for the COR's approval in accordance with Schedule of Values requirement of this contract. Requests for progress payment consideration for such items shall be supported by documents establishing their value and that the title requirements of the clause at FAR 52.232-5 have been met.

d. Materials are adequately insured and protected from theft and exposure.

e. Provide a written consent from the surety company with each payment request for offsite materials.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for general administrative paragraphs.

1.2 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Samples

1.3 SAMPLES

Samples shall be large enough to verify contract requirements. COR has the discretion to request larger samples or a different sample format.

1.4 CONTRACTOR SPECIAL REQUIREMENTS

1.4.1 Asbestos Containing Material

All contract requirements of Section 02 82 14.00 10, ASBESTOS HAZARD CONTROL ACTIVITIES assigned to the Private Qualified Person (PQP) shall be accomplished directly by a first tier subcontractor.

1.5 SUPERVISION

Have at least one qualified supervisor capable of reading, writing, and conversing fluently in the English language on the job site whenever work is being performed under the contract. In addition, if a Quality Control (QC) representative is required on the contract, then that individual shall also have fluent English communication skills.

Provide at least one (1) qualified Project Manager and one (1) on-site Project Superintendent. Both shall comply with English speaking requirements.

In addition to the above experience requirements, the Project Manager and on-site Project Superintendent shall complete the course entitled "Construction Quality Management for Contractors" prior to the start of construction. Contact the COR to schedule attendance in the course.

The Project Manager in this context shall mean the individual with the responsibility for the overall management of the project and the Project Superintendent shall mean the individual with the responsibility for quality and production. Both the Project Manager and Project Superintendent are subject to removal by the COR for non-compliance with requirements specified in the contract and for failure to manage the project to insure timely completion. Furthermore, the COR may issue an

order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time for excess costs or damages by the Contractor.

Approval of Project Manager and on-site Project Superintendent is required prior to start of construction. Provide resumes for the proposed Project Manager and on-site Project Superintendent describing their experience with references and qualifications to the COR for approval. The COR reserves the right to interview the proposed Project Manager and on-site Project Superintendent at any time in order to verify the submitted qualifications.

1.6 PRECONSTRUCTION CONFERENCE

After award of the contract but prior to commencement of any work at the site, meet with the Contracting Officer to discuss and develop a mutual understanding relative to the administration of the value engineering and safety program, preparation of the schedule prices, shop drawings, and other submittals, scheduling programming, and prosecution of the work. Major subcontractors who will engage in the work shall also attend.

1.7 AVAILABILITY OF CADD AND BIM DRAWING FILES

After award and upon request, the electronic "Computer-Aided Design (CAD) and Building Information Model (BIM)" drawing files will be made available to NASA and its Contractor for use in preparation of construction drawings.

Data contained on these electronic files are the property of NASA and shall not be used for any purpose other than as a convenience in the preparation of construction drawings and data for the referenced project. Any other use or reuse shall be at the sole risk of the Contractor and without liability or legal exposure to the Government. The Contractor shall make no claim and waives to the fullest extent permitted by law, any claim or cause of action of any nature against the Government, its agents or sub consultants that may arise out of or in connection with the use of these electronic files. The Contractor shall, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic drawing files are not construction documents. Differences may exist between the electronic drawing files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic drawing files, nor does it make representation to the compatibility of these CAD/BIM files with the Contractor's hardware or software. In the event that a conflict arises between the signed and sealed construction documents prepared by the Government and the furnished CAD/BIM files, the signed and sealed construction documents shall govern. The Contractor is responsible for determining if any conflict exists. Use of these CAD/BIM files does not relieve the Contractor of duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate the work of all contractors for the project.

If the Contractor uses, duplicates and/or modifies these electronic CADD files for use in producing construction drawings and data related to this contract, all previous indicia of ownership (seals, logos, signatures, initials and dates) shall be removed.

1.8 ELECTRONIC MAIL (E-MAIL) ADDRESS

The Contractor shall establish and maintain electronic mail (e-mail) capability along with the capability to open various electronic attachments in Microsoft, Adobe Acrobat, and other similar formats. Within 10 days after contract award, the Contractor shall provide the COR a single (only one) e-mail address for electronic communications from the COR related to this contract including, but not limited to contract documents, invoice information, request for proposals, and other correspondence. The COR may also use e-mail to notify the Contractor of base access conditions when emergency conditions warrant, such as hurricanes, terrorist threats, etc. Multiple e-mail address will not allowed.

It is the Contractor's responsibility to make timely distribution of all COR initiated e-mail with its own organization including field office(s). The Contractor shall promptly notify the COR, in writing, of any changes to this e-mail address.

1.9 COMPUTER AND INTERNET CONNECTION

The Contractor shall maintain a computer and internet connection capable of accessing and using NASA's online construction management system.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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PROJECT SCHEDULE

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for the preparation and maintenance of the project schedule for construction projects or design-build construction projects.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

U.S. ARMY CORPS OF ENGINEERS (USACE)

ECB 2005-10	Scheduling Requirements for Testing of Mechanical Systems in Construction Contracts
ER 1-1-11	Administration -- Progress, Schedules, and Network Analysis Systems

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Project Schedule

1.4 QUALITY ASSURANCE

Designate an authorized representative to be responsible for the preparation of the schedule and all required updating (activity status) and preparation of reports. The authorized representative shall have previously developed, created, and maintained at least 2 electronic schedules for projects similar in nature and complexity to this project and shall be experienced in the use of the scheduling software that meets the requirements of this specification.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Prepare for approval a Project Schedule, as specified herein, pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS. Show in the schedule the sequence in which the Contractor proposes to perform the work and dates on which the Contractor contemplates starting and completing all schedule activities. The scheduling of the entire project, including the design and construction sequences, is required. The scheduling of constructiondesign and construction is the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliersDesigners, Subcontractors and suppliers working on the project shall also contribute in developing and maintaining an accurate Project Schedule. Provide a schedule that is a forward planning as well as a project monitoring tool.

3.1.1 Approved Project Schedule

Use the approved Project Schedule to measure the progress of the work and to aid in evaluating time extensions. Make the schedule cost loaded and activity coded. The schedule will provide the basis for all progress payments. If the Contractor fails to submit any schedule within the time prescribed, the COR may withhold approval of progress payments until the Contractor submits the required schedule.

3.1.2 Schedule Status Reports

Provide a Schedule Status Report on at least a monthly basis. If, in the opinion of the COR, the Contractor falls behind the approved schedule, take steps necessary to improve its progress including those that may be required by the COR, without additional cost to the Government. In this circumstance, the COR may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules as the COR deems necessary to demonstrate how the approved rate of progress will be regained.

3.1.3 Default Terms

Failure of the Contractor to comply with the requirements of the COR shall be grounds for a determination, by the COR, that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the COR may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of the contract.

3.2 BASIS FOR PAYMENT AND COST LOADING

Use the schedule as the basis for determining contract earnings during each update period and therefore the amount of each progress payment. Lack of an approved schedule update, or qualified scheduling personnel, will result in the inability of the COR to evaluate contract earned value for the purposes of payment. Failure of the Contractor to provide all required information will result in the disapproval of the preliminary, initial and subsequent schedule updates. In the event schedule revisions are directed by the COR and those revisions have not been included in subsequent revisions or updates, the COR may hold retainage up to the maximum allowed by contract, each payment period, until such revisions to the Project

Schedule have been made. Activity cost loading shall be reasonable, as determined by the COR. The aggregate value of all activities coded to a contract CLIN shall equal the value of the CLIN on the Schedule.

3.3 PROJECT SCHEDULE DETAILED REQUIREMENTS

The computer software system utilized to produce and update the Project Schedule shall be capable of meeting all requirements of this specification. Failure of the Contractor to meet the requirements of this specification will result in the disapproval of the schedule.

3.3.1 Critical Path Method

Use the Critical Path Method (CPM) of network calculation to generate the Project Schedule. Prepare the Project Schedule using the Precedence Diagram Method (PDM).

3.3.2 Level of Detail Required

Develop the Project Schedule to an appropriate level of detail. Failure to develop the Project Schedule to an appropriate level of detail, as determined by the COR, will result in its disapproval. The COR will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail:

3.3.2.1 Activity Durations

Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. Less than 2 percent of all non-procurement activities shall have Original Durations (OD) greater than 20 work days or 30 calendar days. Procurement activities are defined herein.

3.3.2.2 Design and Permit Activities

Include design and permit activities with the necessary conferences and follow-up actions and design package submission dates. Include the design schedule in the project schedule, showing the sequence of events involved in carrying out the project design tasks within the specific contract period. This shall be at a detailed level of scheduling sufficient to identify all major design tasks, including those that control the flow of work. The schedule shall include review and correction periods associated with each item.

3.3.2.3 Procurement Activities

The schedule must include activities associated with the submittal, approval, procurement, fabrication and delivery of long lead materials, equipment, fabricated assemblies and supplies. Long lead procurement activities are those with an anticipated procurement sequence of over 90 calendar days. A typical procurement sequence includes the string of activities: submit, approve, procure, fabricate, and deliver.

3.3.2.4 Mandatory Tasks

The following tasks must be included and properly scheduled:

a. Submission, review and acceptance of design packages.

b. Submission of mechanical/electrical/information systems layout drawings.

c. Submission and approval of O & M manuals.

d. Submission and approval of as-built drawings.

e. Submission and approval of 1354 data and installed equipment lists.

f. Submission and approval of testing and air balance (TAB).

g. Submission of TAB specialist design review report.

h. Submission and approval of fire protection specialist.

i. Submission and approval of testing and balancing of HVAC plus commissioning plans and data. Develop the schedule logic associated with testing and commissioning of mechanical systems to a level of detail consistent with ECB 2005-10.

j. Air and water balancing.

k. HVAC commissioning.

l. Controls testing plan submission.

m. Controls testing.

n. Performance Verification testing.

o. Other systems testing, if required.

p. Contractor's pre-final inspection.

q. Correction of punchlist from Contractor's pre-final inspection.

r. Government's pre-final inspection.

s. Correction of punch list from Government's pre-final inspection.

t. Final inspection.

3.3.2.5 Government Activities

Show Government and other agency activities that could impact progress. These activities include, but are not limited to: approvals,approvals, design reviews, environmental permit approvals by State regulators, inspections, utility tie-in, and Notice to Proceed (NTP) for phasing requirements.

Coordinate construction activities with NASA throughout construction. Schedule meetings with users in advance to coordinate activities and establish project schedule. Plan work to minimize interference with normal business operations of facility users. Obtain NASA approval for scheduled shutdowns.. Shutdown and permitted activities schedule is subject to change by NASA during project.

3.3.2.6 Activity Responsibility Coding (RESP)

Assign responsibility Code for all activities to the Prime Contractor,

Subcontractor or Government agency responsible for performing the activity. Activities coded with a Government Responsibility code include, but are not limited to: Government approvals, Government design reviews, environmental permit approvals by State regulators, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements. Code all activities not coded with a Government Responsibility Code to the Prime Contractor or Subcontractor responsible to perform the work. Activities shall not have more than one Responsibility Code. Examples of acceptable activity code values are: DOR (for the designer of record); ELEC (for the electrical subcontractor); MECH (for the mechanical subcontractor); and GOVT (for USACE). Unacceptable code values are abbreviations of the names of subcontractors.

3.3.2.7 Activity Work Area Coding

Assign Work Area code to activities based upon the work area in which the activity occurs. Define work areas based on resource constraints or space constraints that would preclude a resource, such as a particular trade or craft work crew, from working in more than one work area at a time due to restraints on resources or space. Examples of Work Area Coding include different areas within a floor of a building, different floors within a building, and different buildings within a complex of buildings. Activities shall not have more than one Work Area Code. Not all activities are required to be Work Area coded. A lack of Work Area coding will indicate the activity is not resource or space constrained.

3.3.2.8 Contract Changes/Requests for Equitable Adjustment (REA) Coding (MODF)

Assign Activity code to any activity or sequence of activities added to the schedule as a result of a Contract Modification, when approved by the COR, with a Contract Changes/REA Code. Key all Code values to the Government's modification numbering system. Any activity or sequence of activities added to the schedule as a result of alleged constructive changes made by the Government may be added to a copy of the current schedule, subject to the approval of the COR. Assign Activity codes for these activities with a Contract Changes/REA Code. Key the code values to the Contractor's numbering system. Approval to add these activities does not necessarily mean the Government accepts responsibility and, therefore, liability for such activities and any associated impacts to the schedule, but rather the Government recognizes such activities are appropriately added to the schedule for the purposes of maintaining a realistic and meaningful schedule. Such activities shall not be Responsibility Coded to the Government unless approved. An activity shall not have more than one Contract Changes/REA Code.

3.3.2.9 Contract Line Item (CLIN) Coding (BIDI)

Code all activities to the CLIN on the Contract Line Item Schedule to which the activity belongs. An activity shall not contain more than one CLIN Item Code. CLIN Item code all activities, even when an activity is not cost loaded.

3.3.2.10 Phase of Work Coding (PHAS)

Assign Phase of Work Code to all activities based upon the phase of work in which the activity occurs. Code activities to either a Design Phase or a Construction Phasea Construction Phase. Code fast track design and constructionconstruction phases proposed by the Contractor to allow

filtering and organizing the schedule by fast track design and construction packages. If the contract specifies construction phasing with separately defined performance periods, identify a Construction Phase Code to allow filtering and organizing the schedule accordingly. Each activity shall be identified with a single project phase and have only one Phase of Work code.

3.3.2.11 Category of Work Coding (CATW)

Assign Category of Work Code to all Activities based upon the category of work to which the activity belongs. Category of Work Code must include, but is not limited to: design, design submittal, design reviews, review conferences, permits, construction submittals,construction submittal approvals, Acceptance, Procurement, Fabrication, Delivery, Weather Sensitive Installation, Non-Weather Sensitive Installation, Start-Up, Test and Turnover. Assign a Category of Work Code to each activity. Each activity shall have only one Category of Work Code.

3.3.2.12 Definable Features of Work Coding (FOW1, FOW2, FOW3)

Assign a Definable Feature of Work Code to appropriate activities based on the definable feature of work to which the activity belongs. Definable Feature of Work is defined in Specification Section 01 45 00.00 10 QUALITY CONTROL. An activity shall not have more than one Definable Feature of Work Code. Not all activities are required to be Definable Feature of Work Coded.

3.3.3 Scheduled Project Completion and Activity Calendars

The schedule interval shall extend from NTP date to the required contract completion date. The contract completion activity (End Project) shall finish based on the required contract duration in the accepted contract proposal, as adjusted for any approved contract time extensions. The first scheduled work period shall be the day after NTP is received by the Contractor. Schedule activities on a calendar to which the activity logically belongs. Activities may be assigned to a 7 day calendar when the contract assigns calendar day durations for the activity such as a Government Acceptance activity. If the Contractor intends to perform physical work less than seven days per week, schedule the associated activities on a calendar with non-work periods identified including weekends and holidays. Assign the Category of Work Code - Weather Sensitive Installation to those activities that are weather sensitive. Original durations must account for anticipated normal adverse weather. The Government will interpret all work periods not identified as non-work periods on each calendar as meaning the Contractor intends to perform work during those periods.

3.3.3.1 Project Start Date

The schedule shall start no earlier than the date on which the NTP was acknowledged. Include as the first activity in the project schedule an activity called "Start Project"(or NTP). The "Start Project" activity shall have an "ES" constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

3.3.3.2 Schedule Constraints and Open Ended Logic

Constrain completion of the last activity in the schedule by the contract completion date. Schedule calculations shall result in a negative float when the calculated early finish date of the last activity is later than

the contract completion date. Include as the last activity in the project schedule an activity called "End Project". The "End Project" activity shall have an "LF" constraint date equal to the contract completion date for the project, and with a zero day duration or by using the "project must finish by" date in the scheduling software. The schedule shall have no constrained dates other than those specified in the contract. The use of artificial float constraints such as "zero fee float" or "zero total float" are typically prohibited. There shall only be 2 open ended activities: Start Project (or NTP) with no predecessor logic and End Project with no successor logic.

3.3.3.3 Early Project Completion

In the event the Preliminary or Initial project schedule calculates an early completion date of the last activity prior to the contract completion date, identify those activities that it intends to accelerate and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. The last activity shall have a late finish constraint equal to the contract completion date and the schedule will calculate positive float. The Government will not approve an early completion schedule with zero float on the longest path. The Government is under no obligation to accelerate activities for which it is responsible to support a proposed early contract completion.

3.3.4 Interim Completion Dates

Constrain contractually specified interim completion dates to show negative float when the calculated early finish date of the last activity in that phase is later than the specified interim completion date.

3.3.4.1 Start Phase

Include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The "Start Phase X" activity shall have an "ES" constraint date equal to the date on which the NTP was acknowledged, and a zero day duration.

3.3.4.2 End Phase

Include as the last activity for a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have an "LF" constraint date equal to the specified completion date for that phase and a zero day duration.

3.3.4.3 Phase "X" Hammock

Include a hammock type activity for each project phase called "Phase X" where "X" refers to the phase of work. The "Phase X" hammock activity shall be logically tied to the earliest and latest activities in the phase.

3.3.5 Default Progress Data Disallowed

Do not automatically update Actual Start and Finish dates with default mechanisms that may be included in the scheduling software. Activity Actual Start (AS) and Actual Finish (AF) dates assigned during the updating process shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the AS and AF dates on the Daily Quality Control report for every in-progress or completed activity, and failure to ensure that the data contained on the Daily Quality Control

reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's updated schedule and the inability of the COR to evaluate Contractor progress for payment purposes. Updating of the percent complete and the remaining duration of any activity shall be independent functions. Disable program features which calculate one of these parameters from the other.

3.3.6 Out-of-Sequence Progress

Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case basis subject to approval by the COR. Propose logic corrections to eliminate all out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule. Correct out of sequence progress that continues for more than two update cycles by logic revision, as approved by the COR.

3.3.7 Negative Lags and Start to Finish Relationships

Lag durations contained in the project schedule shall not have a negative value. Do not use Start to Finish (SF) relationships.

3.3.8 Calculation Mode

Schedule calculations shall retain the logic between predecessors and successors even when the successor activity starts and the predecessor activity has not finished. Software features that in effect sever the tie between predecessor and successor activities when the successor has started and the predecessor logic is not satisfied ("progress override") will not be allowed.

3.3.9 Milestones

The schedule must include milestone activities for each significant project event including but not limited to: milestone activities for each fast track design package released for construction; design complete; foundation/substructure construction complete; superstructure construction complete; building dry-in or enclosure complete to allow the initiation of finish activities; permanent power complete; and building systems commissioning complete.

3.4 PROJECT SCHEDULE SUBMISSIONS

Provide the submissions as described below. The data CD, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

3.4.1 Preliminary Project Schedule Submission

Submit the Preliminary Project Schedule, defining the Contractor's planned operations for the first 90 calendar days for approval within 15 calendar days after the NTP is acknowledged. The approved Preliminary Project Schedule will be used for payment purposes not to exceed 90 calendar days after NTP. Completely cost load the Preliminary Project Schedule to balance the contract award CLINS shown on the Price Schedule. Detail it for the first 90 calendar days. It may be summary in nature for the remaining performance period. It must be early start and late finish constrained and logically tied as previously specified. The Preliminary Project Schedule forms the basis for the Initial Project Schedule specified

herein and must include all of the required Plan and Program preparations, submissions and approvals identified in the contract (for example, Quality Control Plan, Safety Plan, and Environmental Protection Plan) as well as design activities, the planned submissions of all early design packages, permitting activities, design review conference activities and other non-construction activities intended to occur within the first 90 calendar days. Schedule any construction activities planned for the first 90 calendar days after NTP. Constrain planned construction activities by Government acceptance of the associated design package(s) and all other specified Program and Plan approvals. Activity code any activities that are summary in nature after the first 90 calendar days with Responsibility Code (RESP) and Feature of Work code (FOW1, FOW2, FOW3).

3.4.2 Initial Project Schedule Submission

Submit the Initial Project Schedule for approval within 42 calendar days after NTP. The schedule shall demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. The Initial Schedule shall be at a reasonable level of detail as determined by the COR. Include in the design-build schedule detailed design and permitting activities, including but not limited to identification of individual design packages, design submission, reviews and conferences; permit submissions and any required Government actions; and long lead item acquisition prior to design completion. Also cover in the preliminary design-build schedule the entire construction effort with as much detail as is known at the time but, as a minimum, include all construction start and completion milestones, and detailed construction activities through the dry-in milestone,including all activity coding and cost loading. Include the remaining construction, including cost loading, but it may be scheduled summary in nature. As the design proceeds and design packages are developed, fully detail the remaining construction activities concurrent with the monthly schedule updating process. Constrain construction activities by Government acceptance of associated designs. When the design is complete, incorporate into the then approved schedule update all remaining detailed construction activities that are planned to occur after the dry-in milestone.

3.4.3 Design Package Schedule Submission

With each design package submitted to the Government, submit a frag-net schedule extracted from the then current Preliminary, Initial or Updated schedule which covers the activities associated with that Design Package including construction, procurement and permitting activities.

3.4.4 Periodic Schedule Updates

Based on the result of the meeting, specified in PERIODIC SCHEDULE UPDATE MEETINGS, submit periodic schedule updates. These submissions will enable the COR to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgment of the COR or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made. Update the schedule to include detailed, lower WBS level construction activities as the design progresses, but not later than the submission of the final, un-reviewed design submission for each separate design package. The COR may require submission of detailed schedule activities for any distinct construction that is started prior to submission of a final design submission, if such activity is authorized.

3.4.5 Standard Activity Coding Dictionary

Use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11, Appendix A. This exact structure is mandatory, even if some fields are not used. A template SDEF compatible schedule backup file (sdef.prx) is available on the QCS website: www.rmssupport.com. The SDEF format is as follows:

	Field Code	Activity Length	Description
1	WRKP	3	Workers per Day
2	RESP	4	Responsible Party (e.g. GC, subcontractor, USACE)
3	AREA	4	Area of Work
4	MODF	6	Modification or REA number
5	BIDI	6	Bid Item (CLIN)
6	PHAS	2	Phase of Work
7	CATW	1	Category of Work
8	FOW1	10	Feature of Work (used up to 10 characters in length)
9	FOW2	10	Feature of Work (used up to 20 characters in length)
10	FOW3	10	Feature of Work (used up to 30 characters in length)

3.5 SUBMISSION REQUIREMENTS

Submit the following items for the Preliminary Schedule, Initial Schedule, and every Periodic Schedule Update throughout the life of the project:

3.5.1 Narrative Report

Provide a Narrative Report with the Preliminary, Initial, and each Periodic Update of the project schedule, as the basis of the progress payment request. The Narrative Report shall include: a description of activities along the 2 most critical paths where the total float is less than or equal to 20 work days, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to communicate to the Government, the Contractor's thorough analysis of the schedule output and its plans to compensate for any problems, either current or potential, which are revealed through that analysis. Identify and explain why any activities that, based their calculated late dates, should have either started or finished during the update period but did not.

3.5.2 Approved Changes Verification

Include only those project schedule changes in the schedule submission that have been previously approved by the COR. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

3.5.3 Schedule Reports

The format, filtering, organizing and sorting for each schedule report shall be as directed by the COR. Typically reports shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float, Actual Start Date, Actual Finish Date, and Percent Complete. The following lists typical reports that will be requested. One

or all of these reports may be requested for each schedule submission.

3.5.3.1 Activity Report

A list of all activities sorted according to activity number.

3.5.3.2 Logic Report

A list of detailed predecessor and successor activities for every activity in ascending order by activity number.

3.5.3.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. List activities which have the same amount of total float in ascending order of Early Start Dates. Do not show completed activities on this report.

3.5.4 Network Diagram

The network diagram is required for the Preliminary, Initial and Periodic Updates. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The COR will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.4.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. Show the activity number, description, duration, and estimated earned value on the diagram.

3.5.4.2 Project Milestone Dates

Show dates on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.4.3 Critical Path

Clearly show the critical path.

3.5.4.4 Banding

Organize activities as directed to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

3.5.4.5 S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

3.6 PERIODIC SCHEDULE UPDATE MEETINGS

Conduct periodic schedule update meetings for the purposes of reviewing the Contractor's proposed out of sequence corrections, determining causes for delay, correcting logic, maintaining schedule accuracy and determining earned value. Meetings shall occur at least monthly within five days of the proposed schedule data date and after the Contractor has updated the

schedule with Government concurrence respecting actual start dates, actual finish dates, remaining durations and percent complete for each activity it intend to status. Provide a computer with the scheduling software loaded and a projector during the meeting which allows all meeting participants to view the proposed schedule update during the meeting. The meeting and resultant approvable schedule update shall be a condition precedent to a formal submission of the update as described in SUBMISSION REQUIREMENTS and to the submission of an invoice for payment. The meeting will be a working interactive exchange which will allow the Government and the Contractor the opportunity to review the updated schedule on a real time and interactive basis. The Contractor's authorized scheduling representative will organize, sort, filter and schedule the update as requested by the Government. The meeting will last no longer than 8 hours. A rough draft of the proposed activity logic corrections and narrative report shall be provided to the Government 48 hours in advance of the meeting. The Contractor's Project Manager and Authorized Scheduler shall attend the meeting with the Authorized Representative of the COR.

3.6.1 Update Submission Following Progress Meeting

Submit a complete update of the project schedule containing all approved progress, revisions, and adjustments, pursuant to paragraph SUBMISSION REQUIREMENTS not later than 4 working days after the periodic schedule update meeting, reflecting only those changes made during the previous update meeting.

3.6.2 Status of Activities

Update information, including Actual Start Dates (AS), Actual Finish Dates (AF), Remaining Durations (RD), and Percent Complete shall be subject to the approval of the Government prior to the meeting. As a minimum, address the following items on an activity by activity basis during each progress meeting.

3.6.2.1 Start and Finish Dates

Accurately show the status of the AS and/or AF dates for each activity currently in-progress or completed since the last update. The Government may allow an AF date to be assigned with the percent complete less than 100% to account for the value of work remaining but not restraining successor activities. Only assign AS dates when actual progress occurs on an activity.

3.6.2.2 Remaining Duration

Update the estimated RD for all incomplete activities independent of Percent Complete. Remaining Durations may exceed the activity OD or may exceed the activity's prior update RD if the Government considers the current OD or RD to be understated based on current progress, insufficient work crews actually manning the job, unrealistic OD or deficiencies that must be corrected that restrain successor activities.

3.6.2.3 Percent Complete

Update the percent complete for each activity started, based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete. To allow for proper schedule management, cost load the correction of punch

list from Government pre-final inspection activity(ies) not less than 1 percent of the total contract value, which activity(ies) may be declared 100 percent complete upon completion and correction of all punch list work identified during Government pre-final inspection(s).

3.6.2.4 Logic Changes

Specifically identify and discuss all logic changes pertaining to NTP on change orders, change orders to be incorporated into the schedule, Contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, and other changes that have been made pursuant to contract provisions. The Government will only approve logic revisions for the purpose of keeping the schedule valid in terms of its usefulness in calculating a realistic completion date, correcting erroneous logic ties, and accurately sequencing the work.

3.6.2.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities include: 1) delays beyond the Contractor's control, such as strikes and unusual weather. 2) delays encountered due to submittals, Government Activities, deliveries or work stoppages which make re-planning the work necessary. 3) Changes required to correct a schedule that does not represent the actual or planned prosecution and progress of the work.

3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor believes it is entitled to an extension of the contract performance period, completion date, or any interim milestone date, furnish the following for a determination by the COR: justification, project schedule data, and supporting evidence as the COR may deem necessary. Submission of proof of excusable delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is a condition precedent to any approvals by the Government. In response to each Request For Proposal issued by the Government, submit a schedule impact analysis demonstrating whether or not the change contemplated by the Government impacts the critical path.

3.7.1 Justification of Delay

The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with this request. The COR's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay, will not be a cause for an extension to the performance period, completion date, or any interim milestone date.

3.7.2 Submission Requirements

Submit a justification for each request for a change in the contract completion date of less than 2 weeks based upon the most recent schedule update at the time of the NTP or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

a. A list of affected activities, with their associated project schedule

activity number.

b. A brief explanation of the causes of the change.

c. An analysis of the overall impact of the changes proposed.

d. A sub-network of the affected area.

Identify activities impacted in each justification for change by a unique activity code contained in the required data file.

3.7.3 Additional Submission Requirements

The COR may request an interim update with revised activities for any requested time extension of over 2 weeks. Provide this disk within 4 days of the COR's request.

3.8 DIRECTED CHANGES

If the NTP is issued for changes prior to settlement of price and/or time, submit proposed schedule revisions to the COR within 2 weeks of the NTP being issued. The COR will approve proposed revisions to the schedule prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the COR may furnish the Contractor with suggested revisions to the project schedule. Include these revisions in the project schedule until revisions are submitted, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the COR, advise the COR within 2 weeks of receipt of the revisions. Regardless of the objections, continue to update the schedule with the COR's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the COR's proposed revisions, the Contractor will be deemed to have concurred with the COR's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

3.9 3-WEEK LOOK AHEAD SCHEDULE

The Contractor shall prepare and issue a 3-Week Look Ahead schedule to provide a more detailed day-to-day plan of upcoming work identified on the Construction Schedule. The work plans shall be updated each week to show the planned work for the current and following two-week period. Additionally, include upcoming outages, closures, preparatory meetings, and initial meetings. Identify critical path activities on the Three-Week Look Ahead Schedule. The detail work plans are to be bar chart type schedules, maintained separately from the Construction Schedule on an electronic spreadsheet program and printed on 8 ½ by 11 or 11 by 17 sheets as directed by the COR. Activities shall not exceed 5 working days in duration and have sufficient level of detail to assign crews, tools and equipment required to complete the work. Hard copies for each attendee of the weekly Progress Meeting, and one electronic file of the 3-Week Look Ahead Schedule, shall be delivered and reviewed during the weekly Progress Meeting.

3.10 CORRESPONDENCE AND TEST REPORTS

All correspondence (e.g., letters, Requests for Information (RFIs), e-mails, meeting minute items, Production and QC Daily Reports, material delivery tickets, photographs, etc.) shall reference Schedule activities

that are being addressed. All test reports (e.g., concrete, soil compaction, weld, pressure, etc.) shall reference schedule activities that are being addressed.

3.11 WEEKLY PROGRESS MEETINGS

a. Meet weekly with the Government (or as otherwise mutually agreed to) between the meetings described in paragraph PERIODIC SCHEDULE UPDATE MEETINGS for the purpose of jointly reviewing the actual progress of the project as compared to the as planned progress and to review planned activities for the upcoming two weeks. The then current and approved schedule update shall be used for the purposes of this meeting and for the production and review of reports. The Contractor's Project Manager and the Authorized Representative of the COR shall attend. The weekly progress meeting will address the status of RFI's, RFP's and Submittals.

b. Provide a bar chart produced by the scheduling software, organized by Total Float and Sorted by Early Start Date, and a two week "look-ahead" schedule by filtering all schedule activities to show only current ongoing activities and activities schedule to start during the upcoming two weeks, organized by Work Area Code (AREA) and sorted by Early Start Date.

c. The Government and the Contractor shall jointly review the reports. If it appears that activities on the longest path(s) which are currently driving the calculated completion date (driving activities), are not progressing satisfactorily and therefore could jeopardize timely project completion, corrective action must be taken immediately. Corrective action includes but is not limited to: increasing the number of work crews; increasing the number of work shifts; increasing the number of hours worked per shift; and determining if Government responsibility coded activities require Government corrective action.

3.12 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

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SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for general procedures regarding submittals, data normally submitted for review to establish conformance with the design concept and contract documents.

1.2 GENERAL

The COR may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections.

Units of weights and measures used on all submittals are to be the same as those used in the contract drawings.

Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

Contractor's Quality Control (CQC) System Manager and the Designer of Record, if applicable, to check and approve all items prior to submittal and stamp, sign, and date indicating action taken. Proposed deviations from the contract requirements are to be clearly identified. Include within submittals items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

Submittals requiring Government approval are to be scheduled and made prior to the acquisition of the material or equipment covered thereby. Pick up and dispose of samples not incorporated into the work in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

1.2.1 NASA's Online Construction Management System

All construction documents including but not limited to submittals, requests for information (RFIs), daily reports, field clarifications, schedules, change orders, and progress payment requests shall be submitted and electronically approved through NASA's online construction management system, SharePoint.

Adobe Digital Signatures or other digital signatures as mutually agreed upon by the Government and the Contractor shall be considered legally binding and the equivalent of pen and ink signatures.

The Government reserves the right to select which electronic format is used in documents submitted online provided that format is in widespread public use (such as PDF) and is commercially available for no more than a nominal fee.

Whenever practical the text in documents submitted online shall be electronically searchable information as opposed to scanned or digitally photographed information.

The Government reserves the right to establish naming conventions for any documents submitted to the online construction management system.

The Government reserves the right to provide a form that shall be used for any document submitted online including but not limited to: requests for information and submittal transmittal forms. The text in these documents shall remain electronically searchable when submitted.

1.3 DEFINITIONS

1.3.1 Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by Submittal Description (SD) numbers and titles as follows:

SD-01 Preconstruction Submittals

Submittals which are required to be submitted prior to start of construction (work) issuance of contract notice to proceed or commencing work on site or the start of the next major phase of the construction on a multi-phase contract, includes schedules, tabular list of data, or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

Certificates of insurance

Surety bonds

List of proposed Subcontractors

List of proposed products

Construction Progress Schedule

Submittal register

Schedule of values

Health and safety plan

Work plan

Quality Control(QC) plan

Environmental protection plan

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in

producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

Design drawings require the stamp of a licensed engineer.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

Design submittals, design substantiation submittals and extensions of design submittals.

Design data requires the stamp of a licensed engineer.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

Text of posted operating instructions.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and (MSDS)concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative

requirements or to establish an administrative mechanism.

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.3.2 Approving Authority

Office or designated person authorized to approve submittal.

1.3.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, except those SD-01 Pre-Construction Submittals noted above, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submittal Register

1.5 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.5.1 Submit for Approval

Government approval is required for all submittals described in these specifications, including, but not limited to, extensions of design, critical materials, deviations from the Solicitation, Accepted Proposal or design, substitutions, variations and other items equipment whose compatibility with the entire system must be checked, and other items as designated by the COR. Government approval is required for any as designated by the COR. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction,"they are considered to be "shop drawings."

The Government will review all intermediate and final Design-build design submittals for conformance with the technical requirements of the solicitation. Review will be only for conformance with the applicable codes, standards and contract requirements. Generally,design submittals should be identified as SD-05 Design Data submittals.

1.5.1.1 Deviations to the Accepted Design

The Government's concurrence is required for any proposed deviation from the accepted design which still complies with the contract before the Contractor is authorized to proceed with material acquisition or installation. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction", they are considered to be "shop drawings." If necessary to facilitate the project schedule, the Contractor and the COR may discuss a submittal proposing a deviation prior

to officially submitting it to the Government. However, the Government reserves the right to review the submittal before providing approval. The Government reserves the right to non-concur with any deviation from the design, which may impact furniture, furnishings, equipment selections or operations decisions that were made, based on the reviewed and concurred design.

1.5.1.2 Substitutions

Unless prohibited or provided for otherwise elsewhere in the Contract, where the accepted contract proposal named products, systems, materials or equipment by manufacturer, brand name and/or by model number or other specific identification, and the Contractor desires to substitute manufacturer or model after award, submit a requested substitution for Government concurrence. Include substantiation, identifying information, as meeting the contract requirements and that it is equal in function, performance, quality and salient features to that in the accepted contract proposal. If the Contract otherwise prohibits substitutions of equal named products, systems, materials or equipment by manufacturer, brand name and/or by model number or other specific identification, the request is considered a "variation" to the contract. Variations are discussed below in paragraph: "1.10 VARIATIONS".

1.5.2 For Information Only

At the COR's discretion a submittal may be designated "For Information Only". Such submittals are part of the project record but do not require government review or approval.

1.5.3 Government Conformance Review of Design (CR)

The Government will review all intermediate and final design submittals for conformance with the technical requirements of the solicitation. Section 01 33 16 DESIGN AFTER AWARD covers the design submittal and review process in detail. Review will be only for conformance with the applicable codes, standards and contract requirements. Design data includes the design documents described in Section 01 33 16 DESIGN AFTER AWARD. Generally, design submittals should be identified as SD-05 Design Data submittals.

1.5.4 Designer of Record Approved/Government Conformance Review (DA/CR)

1.5.4.1 Deviations to the Accepted Design

Designer of Record approval and the Government's concurrence are required for any proposed deviation from the accepted design which still complies with the contract before the Contractor is authorized to proceed with material acquisition or installation. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction", they are considered to be "shop drawings." If necessary to facilitate the project schedule, the Contractor and the DOR may discuss a submittal proposing a deviation with the COR's Representative prior to officially submitting it to the Government. However, the Government reserves the right to review the submittal before providing an opinion, if deemed necessary. In any case, the Government will not formally agree to or provide a preliminary opinion on any deviation without the DOR's approval or recommended approval. The Government reserves the right to non-concur with any deviation from the design, which may impact furniture, furnishings, equipment selections or operations decisions that were made, based on the reviewed and concurred design.

1.5.4.2 Substitutions

Unless prohibited or provided for otherwise elsewhere in the Contract, where the accepted contract proposal named products, systems, materials or equipment by manufacturer, brand name and/or by model number or other specific identification, and the Contractor desires to substitute manufacturer or model after award, submit a requested substitution for Government concurrence. Include substantiation, identifying information and the DOR's approval, as meeting the contract requirements and that it is equal in function, performance, quality and salient features to that in the accepted contract proposal. If the Contract otherwise prohibits substitutions of equal named products, systems, materials or equipment by manufacturer, brand name and/or by model number or other specific identification, the request is considered a "variation" to the contract. Variations are discussed below in paragraphs: "Designer of Record Approved/Government Approved" and "VARIATIONS"

1.5.5 Designer of Record Approved/Government Approved (DA/GA)

In addition to the above stated requirements for proposed deviations to the accepted design, both Designer of Record and Government Approval and, where applicable, a contract modification are required before the Contractor is authorized to proceed with material acquisition or installation for any proposed variation to the contract (the solicitation and/or the accepted proposal), which constitutes a change to the contract terms. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction," they are considered to be "shop drawings." The Government reserves the right to accept or reject any such proposed deviation at its discretion.

1.5.6 Information Only

Submittals not requiring Government approval will be for information only. For Design-build construction all submittals not requiring Designer of Record or Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.6 FORWARDING SUBMITTALS REQUIRING GOVERNMENT APPROVAL

1.6.1 Submittals Required from the Contractor

As soon as practicable after award of contract, and before procurement of fabrication, forward to the COR, submittals required in the technical sections of this specification, including shop drawings, product data and samples.

1.7 PREPARATION

1.7.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels to the COR. Transmit submittals with transmittal form prescribed by the COR and standard for project. On the transmittal form identify Contractor, indicate date of submittal, and include information prescribed by transmittal form.

Use the transmittal form provided by the COR for submitting both Government

approved and information only submittals. Properly complete this form by filling out all the heading blank spaces and identifying each item submitted. Exercise special care to ensure proper listing of the specification paragraph and sheet number of the contract drawings pertinent to the data submitted for each item.

1.7.2 Identifying Submittals

When submittals are provided by a Subcontractor, the Prime Contractor is to prepare, review and sign with Contractor's approval, the transmittal form prior to submitting for Government approval.

1.7.3 Format for SD-02 Shop Drawings

Shop drawings are not to be formatted at less than 8 1/2 by 11 inches nor more than 30 by 42 inches, except for full size patterns or templates. Prepare drawings to accurate size, with scale indicated, unless other form is required. Drawings are to be suitable for reproduction and be of a quality to produce clear, distinct lines and letters with dark lines on a white background.

Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph entitled, "Identifying Submittals," of this section.

Number drawings in a logical sequence. Contractors may use their own number system. Each drawing is to bear the number of the submittal in a uniform location adjacent to the title block. Place the Government contract number in the margin, immediately below the title block, for each drawing.

Reserve a blank space, no smaller than 3 by 3 inches on the right hand side of each sheet for the Government disposition stamp.

Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Use the same unit of measure for shop drawings as indicated on the contract drawings. Identify materials and products for work shown.

Include the nameplate data, size and capacity on drawings. Also include applicable federal, state, industry and technical society publication references.

1.7.4 Format of SD-03 Product Data and SD-08 Manufacturer's Instructions

Present product data submittals for each section as a complete volume. Include table of contents, listing page and catalog item numbers for product data.

Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains.

Supplement product data with material prepared for project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for project, with information and format as required for submission of SD-07 Certificates.

Include the manufacturer's name, trade name, place of manufacture, and catalog model or number on product data. Also include applicable federal,

state, industry and technical society publication references. Should manufacturer's data require supplemental information for clarification, submit as specified for SD-07 Certificates.

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the COR. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

Collect required data submittals for each specific material, product, unit of work, or system into a single submittal and marked for choices, options, and portions applicable to the submittal. Mark each copy of the product data identically. Partial submittals will be accepted for expedition of construction effort at the COR's discretion.

Submit manufacturer's instructions prior to installation.

1.7.5 Format of SD-04 Samples

Furnish samples in sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples approximately same size as specified:

a. Sample of Equipment or Device: Full size.

b. Sample of Materials Less Than 2 by 3 inches: Built up to 8 1/2 by 11 inches.

c. Length of Linear Devices or Materials: 10 inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.

d. Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.

e. Color Selection Samples: 2 by 4 inches. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes and quantities of samples are to represent their respective standard unit.

f. Sample Panel: 4 by 4 feet.

g. Sample Installation: 100 square feet.

Samples Showing Range of Variation: Where variations in color, finish, pattern, or texture are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range. Mark each unit to describe its relation to the range of the variation.

Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples are to be in undamaged

condition at time of use.

Recording of Sample Installation: Note and preserve the notation of area constituting sample installation but remove notation at final clean up of project.

When color, texture or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.7.6 Format of SD-05 Design Data and SD-07 Certificates

Provide design data and certificates sized at 8 1/2 by 11 inches.

1.7.7 Format of SD-06 Test Reports and SD-09 Manufacturer's Field Reports

Indicate by prominent notation, each report in the submittal. Indicate specification number and paragraph number to which it pertains.

1.7.8 Format of SD-10 Operation and Maintenance Data (O&M)

Comply with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA for O&M Data format.

1.7.9 Format of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

When submittal includes a document which is to be used in project or become part of project record, other than as a submittal, do not apply Contractor's approval stamp to document, but to a separate sheet accompanying document.

1.8 QUANTITY OF SUBMITTALS

1.8.1 Number of Samples SD-04 Samples

a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by approving authority and one will be returned to Contractor.

b. Submit one sample panel or provide one sample installation where directed. Include components listed in technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of non-solid materials.

1.9 for INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the COR is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the COR from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

1.10 VARIATIONS

A contract modification is are required before the Contractor is authorized to proceed with material acquisition or installation for any proposed variation to the contract (the solicitation and/or the accepted proposal), which constitutes a change to the contract terms. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction," they are considered to be "shop drawings." The Government reserves the right to accept or reject any such proposed deviation at its discretion.

Variations from contract requirements require Government approval pursuant to contract clause FAR 52.236-21 and will be considered where advantageous to Government.

1.10.1 Considering Variations

Discussion with COR prior to submission will help ensure functional and quality requirements are met and minimize rejections and re-submittals. When contemplating a variation which results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

Specifically point out variations from contract requirements in transmittal letters. Failure to point out deviations may result in the Government requiring rejection and removal of such work at no additional cost to the Government.

1.10.2 Proposing Variations

When proposing variation, deliver written request to the COR, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Government, including the DOR's written analysis and approval. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

1.10.3 Warranting That Variations Are Compatible

When delivering a variation for approval, Contractor, including its Designer(s) of Record, warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.10.4 Review Schedule Is Modified

In addition to normal submittal review period, a period of 5 working days will be allowed for consideration by the Government of submittals with variations.

1.11 SUBMITTAL REGISTER AND DATABASE

Prepare and maintain submittal register, as the work progresses. Use electronic submittal register program furnished by the Government or any other format. Do not change data which is output in columns (c), (d), and (e) as delivered by Government; retain data which is output in columns (a), (f), (g), and (h) as approved. A submittal register showing items of equipment and materials for which submittals are required by the specifications is provided as an attachment. This list may not be all

inclusive and additional submittals may be required. Maintain a submittal register for the project in accordance with Section 01 45 00.00 40 QUALITY CONTROL.

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD No. and type, e.g. SD-02 Shop Drawings) required in each specification section.

Column (e): Lists one principal paragraph in specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting project requirements.

The Contractor shall develop a complete list of submittals when preparing the Submittal Register and identify required submittals based on those listed in the specifications and as required by other parts of the contract. The Contractor is required to complete the submittal register and submit it to the COR for approval within 30 calendar days after Notice to Proceed. The approved submittal register will serve as a scheduling document for submittals and will be used to control submittal actions throughout the contract period. Coordinate the submit dates and need dates with dates in the Contractor prepared progress schedule. Submit monthly or until all submittals have been satisfactorily completed, updates to the submittal register showing the Contractor action codes and actual dates with Government action codes. Revise the submittal register when the progress schedule is revised and submit both for approval.

1.11.1 Use of Submittal Register

Submit submittal register in electronic form. Submit with QC plan and project schedule. Verify that all submittals required for project are listed and add missing submittals. Coordinate and complete the following fields on the register database submitted with the QC plan and the project schedule:

Column (a) Activity Number: Activity number from the project schedule.

Column (f) Contractor Submit Date: Scheduled date for approving authority to receive submittals.

Column (g) Contractor Approval Date: Date Contractor needs approval of submittal.

Column (h) Contractor Material: Date that Contractor needs material delivered to Contractor control.

1.11.2 Copies Delivered to the Government

Deliver one copy of submittal register updated by Contractor to Government with each invoice request. Deliver in electronic format, unless a paper copy is requested by COR.

1.12 SCHEDULING

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals.

a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements.

b. Submittals called for by the contract documents will be listed on the register. If a submittal is called for but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the COR does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the register or marked "N/A."

1.12.1 Constraints

Conform to provisions of this section, unless explicitly stated otherwise for submittals listed or specified in this contract.

Submit complete submittals for each definable feature of work. Submit at the same time components of definable feature interrelated as a system.

When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, submittal will be returned without review.

Approval of a separate material, product, or component does not imply approval of assembly in which item functions.

1.13 GOVERNMENT APPROVING AUTHORITY

The Government will:

a. Review submittals and RFIs and provide pertinent disposition within 10 working days after receipt. Failure by the Government to complete review within this time may be grounds for a time extension but not a change in contract price, unless the delay is over 30 calendar days.

b. Note date on which submittal was received from the Contractor.

c. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

d. Identify returned submittals with one of the actions defined in paragraph entitled, "Review Notations," of this section and with markings appropriate for action indicated.

1.13.1 Review Notations

The Government review will be completed within 10 working days after date of submission. Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "Approved" or "Accepted" authorize the Contractor to proceed with the work covered.

b. Submittals marked "Approved as Noted", "Approved as Corrected", "or "Approved Except as Noted, Resubmittal Not Required," authorize the Contractor to proceed with the work covered provided he takes no

exception to the corrections.

c. Submittals marked "Not Approved", "Disapproved," "Resubmit" or "Revise and Resubmit," indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.

d. Submittals marked "Not Reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "Not Reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

1.14 REVISE AND RESUBMIT SUBMITTALS

Contractor shall make corrections required by the Government. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes," is to be given to the COR. Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.15 APPROVED SUBMITTALS

The Government's approval or acceptance of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing and other information are satisfactory. design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal.

Approval or acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work design, dimensions, all design extensions, such as the design of adequate connections and details, etc., and the satisfactory construction of all work.

After submittals have been approved or accepted by the Government, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.16 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, the Contractor to assure that the materials or equipment will be available in quantities required in the

project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Government reserves the right to disapprove any material or equipment which previously has proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the COR for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor to replace such materials or equipment to meet contract requirements.

Approval of the Contractor's samples by the COR does not relieve the Contractor of his responsibilities under the contract.

1.17 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained. No payment for materials incorporated in the work will be made if all required approvals have not been obtained. No payment will be made for any materials incorporated into the work for any conformance review submittals or information only submittals found to contain errors or deviations from the Solicitation or Accepted Proposal.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for safety and occupational health requirements for the protection of Contractor and Government personnel, property and resources.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.32	Fall Protection
ASSE/SAFE A10.34	Protection of the Public on or Adjacent to Construction Sites
ASSE/SAFE Z359.1	Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

ASME INTERNATIONAL (ASME)

ASME B30.22	Articulating Boom Cranes
ASME B30.3	Tower Cranes
ASME B30.5	Mobile and Locomotive Cranes
ASME B30.8	Floating Cranes and Floating Derricks

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA NPR 8621.1	NASA Mishap Reporting, Investigating and Record Keeping Policy
NASA NPG 8715.3	NASA Safety Manual
NASA-STD 8719.12	Safety Standard for Explosives, Propellants, and Pyrotechnics
APR 1700.1	Ames Health and Safety Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	Standard for Portable Fire Extinguishers
NFPA 241	Standard for Safeguarding Construction,Alteration, and Demolition Operations
NFPA 306	Standard for Control of Gas Hazards on Vessels
NFPA 51B	Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	National Electrical Code
NFPA 70E	Standard for Electrical Safety in the Workplace

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electric Code

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP)

Activity Hazard Analysis (AHA)

Crane Critical Lift Plan

Proof of qualification for Crane Operators

SD-06 Test Reports

Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."

Accident Reports

Crane Reports

Gas Protection for NASA projects

SD-07 Certificates

Confined Space Entry Permit

Hot work permit

License Certificates

Certificate of Compliance (Crane)

1.4 DEFINITIONS

a. High Visibility Accident. Any mishap which may generate publicity and/or high visibility.

b. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

c. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:

1. Death, regardless of the time between the injury and death, or the length of the illness;

2. Days away from work (any time lost after day of injury/illness onset);

3. Restricted work;

4. Transfer to another job;

5. Medical treatment beyond first aid;

6. Loss of consciousness; or

7. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

d. "USACE" property and equipment specified in USACE EM 385-1-1 should be interpreted as Government property and equipment.

e. Weight Handling Equipment (WHE) Accident. A WHE accident occurs when any one or more of the six elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; and/or collision, including unplanned contact between the load, crane, and/or other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, roll over, etc.) Any mishap meeting the criteria described above shall be documented in both the Contractor Significant Incident Report (CSIR) and using the NAVFAC prescribed Navy Crane Center (NCC) form submitted within five days both as provided by the COR.

1.5 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.5.1 Personnel Qualifications

1.5.1.1 Site Safety and Health Officer (SSHO)

The contractor shall provide a Safety oversight team that includes a minimum of one (1) Competent Person at each project site to function as the Safety and Health Officer (SSHO). The SSHO shall be at the work site at all times, unless specified differently in the contract, to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor, and their training, experience, and qualifications shall be as required by EM 385-1-1 paragraph 01.A.17 and all associated sub-paragraphs. A Competent Personal shall be provided for all of the hazards identified in the Contractor's Safety and Health Program in accordance with the accepted Accident Prevention Plan, and shall be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. The credentials of the Competent Persons(s) shall be approved by the COR in consultation with the Safety Office.

The Contractor Quality Control (QC) person cannot be the SSHO on this project, even though the QC has safety inspection responsibilities as part of the QC duties.

1.5.1.2 Construction Safety Hazard Awareness Training

The training requirements for the Site Safety and Health Officer (SSHO) must include the successful completion of the course entitled "Construction Safety Hazard Awareness Training for Contractors". If the SSHO does not have a current certification, they must obtain the course certification within sixty (60) calendar days from award. For Construction Safety Requirements refer to NASA Ames Policy Requirements APR 1700.1 Chapter 27 regarding Construction Safety Requirements and Procedures.

1.5.1.3 Crane Operators

Meet the crane operators requirements in USACE EM 385-1-1, Section 16 and Appendix I. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacitates of 50,000 pounds or greater, designate crane operators as qualified by a source that qualifies crane operators (i.e., union, a government agency, or and organization that tests and qualifies crane operators). Provide proof of current qualification.

1.5.2 Personnel Duties

1.5.2.1 Site Safety and Health Officer (SSHO)

a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily quality control report.

b. Conduct mishap investigations and complete required reports. Maintain the OSHA Form 300 and Daily Production reports for prime and sub-contractors.

c. Maintain applicable safety reference material on the job site.

d. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.

e. Implement and enforce accepted APPS and AHAs.

f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. Post a list of unresolved safety and health deficiencies on the safety bulletin board.

g. Ensure sub-contractor compliance with safety and health requirements.

Failure to perform the above duties will result in dismissal of the superintendent, QC Manager, and/or SSHO, and a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

h. Maintain a list of hazardous chemicals on site and their material safety data sheets.

1.5.3 Meetings

1.5.3.1 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent, site safety and health officer, quality control supervisor, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the COR's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

c. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the preconstruction conference, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

1.5.3.2 Safety Meetings

Conduct and document meetings as required by EM 385-1-1. Attach minutes showing contract title, signatures of attendees and a list of topics discussed to the Contractor's daily report.

1.6 ACCIDENT PREVENTION PLAN (APP)

Use a qualified person to prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Accident Prevention Plan" and show compliance with NASA NPG 8715.3. Specific

requirements for some of the APP elements are described below. The APP shall be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer, the Contractor Quality control Manager, and any designated CSP and/or CIH.

Submit the APP to the COR at the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.

Once accepted by the COR, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the COR, until the matter has been rectified.

Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the COR, project superintendent, SSHO and quality control manager. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the COR within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34,) and the environment.

Copies of the accepted plan will be maintained at the COR's office and at the job site. Continuously reviewed and amended the APP, as necessary, throughout the life of the contract. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered.

1.6.1 EM 385-1-1 Contents

In addition to the requirements outlines in Appendix A of USACE EM 385-1-1, the following is required:

a. Confined Space Entry Plan. Develop a confined and/or enclosed space entry plan in accordance with USACE EM 385-1-1, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, OSHA Directive 2.100, and any other federal, state and local regulatory requirements identified in this contract. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

b. Fall Protection and Prevention (FP&P) Program Documentation. The

program documentation shall be site specific and address all fall hazards in the work place and during different phases of construction. Address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 6 feet. A qualified person for fall protection shall prepare and sign the program documentation. Include fall protection and prevention systems, equipment and methods employed for every phase of work, responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods. Revise the Fall Protection and Prevention Program documentation every six months for lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits. Keep and maintain the accepted Fall Protection and Prevention Program documentation at the job site for the duration of the project. Include the Fall Protection and Prevention Program documentation in the Accident Prevention Plan (APP).

c. Lead Compliance Plan. The safety and health aspects of lead work, prepared in accordance with Section 02 83 13.00 20 LEAD IN CONSTRUCTION.

d. Asbestos Hazard Abatement Plan. The safety and health aspects of asbestos work, prepared in accordance with Section 02 82 14.00 10.

e. Site Demolition Plan. The safety and health aspects prepared in accordance with Section 02 41 00 DEMOLITION and referenced sources. Include engineering survey as applicable.

f. Excavation Plan. The safety and health aspects prepared in accordance with Section 31 00 00 EARTHWORK.

1.7 ACTIVITY HAZARD ANALYSIS (AHA)

The Activity Hazard Analysis (AHA) format shall be in accordance with USACE EM 385-1-1, Section 1. Submit the AHA for review at least 10 calendar days prior to the start of each phase. Format subsequent AHAs as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.

Develop the activity hazard analyses using the project schedule as the basis for the activities performed. Any activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the COR.

1.8 DISPLAY OF SAFETY INFORMATION

Within 1 working day after commencement of work, erect a safety bulletin board at the job site. Where size, duration, or logistics of project do not facilitate a bulletin board, an alternative method, acceptable to the COR, that is accessible and includes all mandatory information for employee and visitor review, shall be deemed as meeting the requirement for a bulletin board. Include and maintain information on safety bulletin board as required by EM 385-1-1, section 01.A.06. Additional items required to be posted include:

a. Confined space entry permit.

b. Hot work permit.

c. Emergency phone numbers.

d. MSDS.

1.9 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturer's manuals.

1.10 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment.

1.11 REPORTS

1.11.1 Mishap Reports

a. Conduct a mishap investigation for recordable injuries and illnesses, as defined in 1.3.h and property damage mishaps resulting in at least $2,000 in damages, to establish the root cause(s) of the accident, complete the report and provide the report to the COR within 1 working day of the mishap. The COR will provide copies of any required or special forms.

b. Conduct an accident investigation for any weight handling equipment accident (including rigging gear accidents) to establish the root cause(s) of the accident, complete the WHE Accident Report (Crane and Rigging Gear) form and provide the report to the COR within 30 calendar days of the accident. Do not proceed with crane operations until cause is determined and corrective actions have been implemented to the satisfaction of the COR. The COR will provide a blank copy of the accident report form.

1.11.2 Accident Notification

Notify the COR as soon as practical, but not later than two hours, after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than $2,000, or any weight handling equipment accident in accordance with NASA NPR 8621.1. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted.

1.11.3 Crane Reports

Submit crane inspection reports required in accordance with USACE EM 385-1-1, Appendix I and as specified herein with Daily Reports of Inspections.

1.12 HOT WORK

Submit and obtain a written permit prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, from the Code Q representative. A permit is required from the Explosives Safety Office for work in and around where explosives are processed, stored, or handled. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. The Contractor will provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO NASA AMES DISPATCH. Dial 9-1-1 from a land line. Dial 650-604-5555 from a cell phone.

1.13 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the COR.

1.14 GAS PROTECTION

Contractor shall have one or more employees properly trained and experienced in operation and calibration of gas testing equipment and formally qualified as gas inspectors who shall be on duty during times workers are in confined spaces. Their primary functions shall be to test for gas and operate testing equipment. Unless equipment of constant supervisory type with automatic alarm is employed, gas tests shall be made at least every 2 hours or more often when character of ground or experience indicates gas may be encountered. A gas test shall be made before workmen are permitted to enter the excavation after an idle period exceeding one-half hour.

Readings shall be permanently recorded daily, indicating the concentration of gas, point of test, and time of test. Submit copies of the gas test readings to the COR at the end of each work day.

Special requirements, coordination, and precautions will apply to areas that contain a hazardous atmosphere or, by virtue of their use or physical character, may be oxygen deficient. A check by Government is required prior to entering confined space. Surveillance and monitoring shall be required in these types of work spaces by both Contractor and Government personnel.

1.15 HIGH NOISE LEVEL PROTECTION

Operations performed by the Contractor that involve the use of equipment with output of high noise levels (jackhammers, air compressors, and explosive-actuated devices) shall be scheduled for during the hours 8 a.m. to 5 p.m . unless otherwise approved in writing by the COR. The government

may further restrict the hours of operation of high noise level equipment at the COR's discretion. Use of any such equipment shall be approved in writing by the COR prior to commencement of work.

1.16 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

1.17 CONFINED SPACE ENTRY REQUIREMENTS.

Contractors entering and working in confined spaces performing shipyard industry work are required to follow the requirements of OSHA 29 CFR 1915 Subpart B. Contractors entering and working in confined spaces performing general industry work are required to follow the requirements of OSHA 29 CFR Part 1926.

1.18 RADIATION SAFETY REQUIREMENTS

License Certificates for radiation materials and equipment shall be submitted to the Contracting Officer and Radiation Safety Office (RSO) for all specialized and licensed material and equipment that could cause fatal harm to construction personnel or to the construction project.

Workers shall be protected from radiation exposure in accordance with 10 CFR 20. Standards for Protection Against Radiation

Loss of radioactive material shall be reported immediately to the Contracting Officer.

Actual exposure of the radiographic film or unshielding the source shall not be initiated until after 5 p.m. on weekdays.

In instances where radiography is scheduled near or adjacent to buildings or areas having limited access or one-way doors, no assumptions shall be made as to building occupancy. Where necessary, the Contracting Officer will direct the Contractor to conduct an actual building entry, search, and alert. Where removal of personnel from such a building cannot be accomplished and it is otherwise safe to proceed with the radiography, a fully instructed employee shall be positioned inside such building or area to prevent exiting while external radiographic operations are in process. Transportation of Regulated Amounts of Radioactive Material will comply with 49 CFR, Subchapter C, Hazardous Material Regulations. Local Fire authorities and the site Radiation Safety officer (RSO) shall be notified of any Radioactive Material use.

Transmitter Requirements: The base policy concerning the use of transmitters such as radios, cell phones, etc., must be adhered to by all contractor personnel. They must also obey Emissions control (EMCON) restrictions.

PART 2 PRODUCTS

2.1 CONFINED SPACE SIGNAGE

Provide permanent signs integral to or securely attached to access covers for new permit-required confined spaces. Signs wording: "DANGER--PERMIT-REQUIRED CONFINED SPACE - DO NOT ENTER -" in bold letters a minimum of one inch in height and constructed to be clearly legible with all paint removed. The signal word "DANGER" shall be red and readable from 5 feet.

2.2 FALL PROTECTION ANCHORAGE

Leave in place fall protection anchorage, conforming to ASSE/SAFE Z359.1, installed under the supervision of a qualified person in fall protection, for continued customer use and so identified by signage stating the capacity of the anchorage (strength and number of persons who may be tied-off to it at any one time).

PART 3 EXECUTION

3.1 CONSTRUCTION AND/OR OTHER WORK

Comply with USACE EM 385-1-1, NFPA 241, the APP, the AHA, Federal and/or State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

3.1.1 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint are prohibited. The COR, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials. The Radiation Safety Officer (RSO) must be notified prior to excepted items of radioactive material and devices being brought on base.

3.1.2 Unforeseen Hazardous Material

The design should have identified materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e. 29 CFR Part 1910.1000). If material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the COR immediately. Within 10 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Contractors are required to apply for utility outages at least 3 business days in advance. As a minimum, the request should include the location of

the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, attend a pre-outage coordination meeting with the COR to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Contractor shall ensure that each employee is familiar with and complies with these procedures and USACE EM 385-1-1, Section 12, Control of Hazardous Energy.

COR will, at the Contractor's request, apply lockout/tagout tags and take other actions that, because of experience and knowledge, are known to be necessary to make the particular equipment safe to work on for government owned and operated systems.

No person, regardless of position or authority, shall operate any switch, valve, or equipment that has an official lockout/tagout tag attached to it, nor shall such tag be removed except as provided in this section. No person shall work on any energized equipment including, but not limited to activities such as erecting, installing, constructing, repairing, adjusting, inspecting, un-jamming, setting up, trouble shooting, testing, cleaning, dismantling, servicing and maintaining machines equipment of processes until an evaluation has been conducted identifying the energy source and the procedures which will be taken to ensure the safety of personnel.

When work is to be performed on electrical circuits, only qualified personnel shall perform work on electrical circuits.

A supervisor who is required to enter an area protected by a lockout/tagout tag will be considered a member of the protected group provided he notifies the holder of the tag stub each time he enters and departs from the protected area.

Identification markings on building light and power distribution circuits shall not be relied on for established safe work conditions.

Before clearance will be given on any equipment other than electrical (generally referred to as mechanical apparatus), the apparatus, valves, or systems shall be secured in a passive condition with the appropriate vents, pins, and locks.

Pressurized or vacuum systems shall be vented to relieve differential pressure completely.

Vent valves shall be tagged open during the course of the work.

Where dangerous gas or fluid systems are involved, or in areas where the environment may be oxygen deficient, system or areas shall be purged, ventilated, or otherwise made safe prior to entry.

3.3.1 Tag Placement

Lockout/tagout tags shall be completed in accordance with the regulations

printed on the back thereof and attached to any device which, if operated, could cause an unsafe condition to exist.

If more than one group is to work on any circuit or equipment, the employee in charge of each group shall have a separate set of lockout/tagout tags completed and properly attached.

When it is required that certain equipment be tagged, the Government will review the characteristics of the various systems involved that affect the safety of the operations and the work to be done; take the necessary actions, including voltage and pressure checks, grounding, and venting, to make the system and equipment safe to work on; and apply such lockout/tagout tags to those switches, valves, vents, or other mechanical devices needed to preserve the safety provided. This operation is referred to as "Providing Safety Clearance."

3.3.2 Tag Removal

When any individual or group has completed its part of the work and is clear of the circuits or equipment, the supervisor, project leader, or individual for whom the equipment was tagged shall turn in his signed lockout/tagout tag stub to the COR. That group's or individual's lockout/tagout tags on equipment may then be removed on authorization by the COR.

3.4 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

Establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures.

3.4.1 Training

Institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protection in accordance with USACE EM 385-1-1, Section 21.B.

3.4.2 Fall Protection Equipment and Systems

Enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, Section 21. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, Paragraphs 21.N through 21.N.04. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with 29 CFR 1926.500, Subpart M, USACE EM 385-1-1 and ASSE/SAFE A10.32.

3.4.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet ASSE/SAFE Z359.1. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 6 feet. The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

3.4.3 Existing Anchorage

Certified (or re-certified) by a qualified person for fall protection existing anchorages, to be used for attachment of personal fall arrest equipment in accordance with ASSE/SAFE Z359.1. Exiting horizontal lifeline anchorages must be certified (or re-certified) by a registered professional engineer with experience in designing horizontal lifeline systems.

3.4.4 Horizontal Lifelines

Design, install, certify and use under the supervision of a qualified person horizontal lifelines for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).

3.4.5 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1 and 29 CFR 1926 Subpart M.

3.4.6 Rescue and Evacuation Procedures

When personal fall arrest systems are used, the contractor must ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP).

3.5 SCAFFOLDING

Each scaffold shall be installed, relocated, and dismantled in accordance with designs and instructions of a registered Professional Engineer, and supervised by a competent design person. Provide employees with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Access scaffold platforms greater than 20 feet maximum in height by use of a scaffold stair system. Do not use vertical ladders commonly provided by scaffold system manufacturers for accessing scaffold platforms greater than

20 feet maximum in height. The use of an adequate gate is required. Ensure that employees are qualified to perform scaffold erection and dismantling. Do not use scaffold without the capability of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection and prevention plan. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward. Give special care to ensure scaffold systems are not overloaded. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material is prohibited. The first tie-in shall be at the height equal to 4 times the width of the smallest dimension of the scaffold base. Place work platforms on mud sills. Scaffold or work platform erectors shall have fall protection during the erection and dismantling of scaffolding or work platforms that are more than six feet. Delineate fall protection requirements when working above six feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.

3.6 EQUIPMENT

3.6.1 Material Handling Equipment

a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.

b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.

c. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

3.6.2 Weight Handling Equipment

a. Equip cranes and derricks as specified in EM 385-1-1, section 16.

b. Notify the COR 15 days in advance of any cranes entering the activity so that necessary quality assurance spot checks can be coordinated. Prior to cranes entering federal activities, a Crane Access Permit must be obtained from the COR. A copy of the permitting process will be provided at the Preconstruction Conference. Contractor's operator shall remain with the crane during the spot check.

c. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, and ASME B30.8 for floating cranes and floating derricks.

d. Under no circumstance shall a Contractor make a lift at or above 90 percent of the cranes rated capacity in any configuration.

e. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and follow the requirements of USACE EM 385-1-1 Section 11 and ASME B30.5 or ASME B30.22 as applicable.

f. Do not crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not

lift personnel with a line hoist or friction crane.

g. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.

h. All employees must keep clear of loads about to be lifted and of suspended loads.

i. Use cribbing when performing lifts on outriggers.

j. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

k. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.

l. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by COR personnel.

m. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by COR personnel.

n. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

3.6.3 Equipment and Mechanized Equipment

a. Proof of qualifications for operator shall be kept on the project site for review.

b. Manufacture specifications or owner's manual for the equipment shall be on-site and reviewed for additional safety precautions or requirements that are sometimes not identified by OSHA or USACE EM 385-1-1. Incorporate such additional safety precautions or requirements into the AHAs.

c. Submit a Machinery & Mechanized Equipment Certification Form for acceptance by the COR prior to being placed into use. A copy of the certification form will be provided during the Pre-construction Conference.

3.6.4 USE OF EXPLOSIVES

Explosives shall not be used or brought to the project site without prior written approval from the COR. Such approval shall not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

Storage of explosives, when permitted on Government property, shall be only where directed and in approved storage facilities. These facilities shall be kept locked at all times except for inspection, delivery, and withdrawal of explosives.

Explosive work shall be performed in accordance with NASA-STD 8719.12. This document is available at:

http://www.hq.nasa.gov/office/codeq/doctree/871912.htm

3.7 EXCAVATIONS

Perform soil classification by a competent person in accordance with 29 CFR 1926.

3.7.1 Utility Locations

Prior to digging, the appropriate digging permit must be obtained. All underground utilities in the work area must be positively identified by a private utility locating service in addition to any station locating service and coordinated with the station utility department. Any markings made during the utility investigation must be maintained throughout the contract.

3.7.2 Utility Location Verification

The Contractor must physically verify underground utility locations by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system. Digging within 2 feet of a known utility must not be performed by means of mechanical equipment; hand digging shall be used. If construction is parallel to an existing utility expose the utility by hand digging every 100 feet if parallel within 5 feet of the excavation.

3.7.3 Shoring Systems

Trench and shoring systems must be identified in the accepted safety plan and AHA. Manufacture tabulated data and specifications or California registered engineer tabulated data for shoring or benching systems shall be readily available on-site for review. Job-made shoring or shielding must have the registered professional engineer stamp, specifications, and tabulated data. Extreme care must be used when excavating near direct burial electric underground cables.

3.7.4 Trenching Machinery

Operate trenching machines with digging chain drives only when the spotters/laborers are in plain view of the operator. Provide operator and spotters/laborers training on the hazards of the digging chain drives with emphasis on the distance that needs to be maintained when the digging chain is operating. Keep documentation of the training on file at the project site.

3.8 UTILITIES WITHIN CONCRETE SLABS

Utilities located within concrete slabs or pier structures, bridges, and the like, are extremely difficult to identify due to the reinforcing steel used in the construction of these structures. Whenever contract work involves concrete chipping, saw cutting, or core drilling, the existing utility location must be coordinated with station utility departments in addition to a private locating service. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the contractor from meeting this requirement.

3.9 ELECTRICAL

3.9.1 Conduct of Electrical Work

Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems. Arrangements are to be coordinated with the COR and Station Utilities for identification. The COR will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers will be permitted to enter. When work requires Contractor to work near energized circuits as defined by the CEC, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. In addition, provide electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA.

3.9.2 Portable Extension Cords

Size portable extension cords in accordance with manufacturer ratings for the tool to be powered and protected from damage. Immediately removed from service all damaged extension cords. Portable extension cords shall meet the requirements of NFPA 70E and OSHA electrical standards.

3.10 WORK IN CONFINED SPACES

Comply with the requirements in Section 34 of USACE EM 385-1-1, OSHA 29 CFR 1910.146 and OSHA 29 CFR 1926.21(b)(6). Any potential for a hazard in the confined space requires a permit system to be used.

-- End of Section --

SECTION 01 35 40.00 20

ENVIRONMENTAL MANAGEMENT

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for responsibilities and requirements regarding environmental management.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z400.1/Z129.1	Hazardous Industrial Chemicals - Material Safety Data Sheets - Preparation

ASTM INTERNATIONAL (ASTM)

ASTM D 4840	Sampling Chain-Of-Custody Procedures
ASTM D 5663	Validating Recycled Content in Packaging Paper and Paperboard
ASTM E 1991	Environmental Life Cycle Assessment of Building Materials/Products
ASTM E 2114	Standard Terminology for Sustainability Relative to the Performance of Buildings
ASTM E 2129	Standard Practices for Data Collection for Sustainability Assessment of Building Products
ASTM E 2432	Standard Guide for General Principles of Sustainability Relative to Buildings

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 14040	Environmental Management - Life Cycle Assessment - Principles and Framework

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST BEES 4.0	Building for Environmental and Economic

Sustainability

U.S. DEPARTMENT OF AGRICULTURE (USDA)

Biomass R&D Act	Biomass Research and Development Act, as amended by 39001 of the Food Conservation and Energy Act of 2008 (2008 Farm Bill or FCEA)
U.S. Farm Bill	Farm Security and Rural Investment Act (2002 Farm Bill) U.S. Farm Bill of May 2002

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

NPDES	National Pollutant Discharge Elimination System

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR	Protection of Environment
40 CFR 261	Identification and Listing of Hazardous Waste

INTERNATIONAL CODE COUNCIL (ICC)

ICC CFC	California Fire Code

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

APR 8553.1	Ames Environmental Management System

1.3 DEFINITIONS

Definitions pertaining to sustainable development are as defined in ASTM E 2114 and as specified.

a. "Biobased content" is calculated as the weight of the biobased material divided by the total weight of the product, and is expressed as a percentage by weight.

b. "Biobased materials" include fuels, chemicals, building materials, or electric power or heat produced from biomass as defined by the Biomass R&D Act. Minimum biobased content shall be as defined in the U.S. Farm Bill.

c. "Chain-of-custody" is a process whereby a product or material is maintained under the physical possession or control during its entire life cycle.

d. "Pollution and environmental damage" is caused by the presence of chemical, physical, or biological elements or agents. Human health or welfare is adversely affected; ecological balances are unfavorably altered; the utility of the environment for aesthetic, cultural, or historical purposes degrades.

e. "Hazardous material" as defined by Chapter 6.95 of the State of California Health and Safety Code, is any material that poses a significant present or potential hazard to human health and safety or

to the environment if released into the workplace or the environment. Common examples are oil, fuel, caustic and acid cleaners, mineral spirits, petroleum distillate based solvents, oil based paints, aerosol spray paints, coolants and antifreeze, and solvents/cleaners containing chlorinated compounds.

"High-GWP refrigerant" means a compound used as a heat transfer or gas that is: (a) a chlorofluorocarbon, a hydrochlorofluorocarbon, a hydrofluorocarbon, a perfluorocarbon, or any compound or blend of compounds, with a GWP (global warming potential) value equal to or greater than 150, or (b) any ozone depleting substance as defined in Title 4 of Code of Federal Regulations, Part 82, Paragraph 82.3.

f. "High-GWP refrigerant" means a compound used as a heat transfer or gas that is: (a) a chlorofluorocarbon, a hydrochlorofluorocarbon, a hydrofluorocarbon, a perfluorocarbon, or any compound or blend of compounds, with a GWP (global warming potential) value equal to or greater than 150, or (b) any ozone depleting substance as defined in Title 4 of Code of Federal Regulations, Part 82, Paragraph 82.3.

g. "Hazardous waste" as defined in California Code of Regulation Title 22, Section 66261.3. Hazardous Waste, includes extremely hazardous waste, acutely hazardous waste, RCRA hazardous waste, non-RCRA hazardous waste and special waste. Examples include waste paint, solvents, PCB transformers, contaminated soil, and oil.

h. "Non-sewerable" includes wastewater that contains at least one contaminant above the allowable discharge limit set by the Publicly Owned Treatment Works (POTWs) for discharge to the sanitary sewer.

i. "Reclamation" as defined by California Code of Regulations, Title 22, Section 66260.10, means that a material is processed to recover a usable product, or that it is regenerated. Examples are recovery of lead from spent batteries and regeneration of spent solvents.

j. "Recycle" is to take something that would otherwise be thrown away and make it into something that can be used again. Examples include fluorescent light tubes and cardboard boxes.

k. "Solid Waste" includes rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, construction, and agricultural operations, and from community activities.

l. "Sustainable" as defined in E.O. 13423, is to create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations of Americans.

1.4 PRECONSTRUCTION MEETING

After award of Contract and prior to commencement of the work, the Contractor shall schedule and conduct a meeting with the COR to discuss the proposed Environmental Protection Plan and to develop a mutual understanding relative to the details of environmental protection. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting as specified in Section 01 45 00.00 10 01 45 00.00 20 01 45 00.00 40 QUALITY CONTROL.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan

Instructor Qualifications

Submit reference data to demonstrate instructors' individual and firm's capabilities and experience.

For projects with a footprint greater than 1 acre:

-- Risk Assessment as defined in the Construction General Permit (CAS000002),

-- Site Map,

-- Storm Water Pollution Prevention Plan (SWPPP) prepared by Qualified SWPPP Developer, as defined in the Construction General Permit (CAS000002),

-- Post-Construction Water Balance Performance Standard Spreadsheet as specified in the Construction General Permit (CAS000002).

Request for Incidental Sewer Discharge form, at least 7 working days before commencement of discharge.

MSDSs of proposed coating and/or adhesive materials, before bringing these materials on-site.

Proposed type and quantity (in pounds) of coatings and/or adhesive materials to be used for the project. Ames tracks all coating usage in a facility wide air permit that limits the use of coatings that can be used in any consecutive 12-month period. If a project may cause Ames to exceed the permit limit, a special permit for coatings will be needed.

For projects that require installation of diesel engines (generators, water pumps, fire pumps, air compressors, etc.), provide specifications detailing engine rating (horsepower, HP), air emissions, engine EPA Tier, and other relevant data. Engines greater than 50 HP are subject to air permitting per BAAQMD Regulation 2-1-114.2.1.

For projects utilizing portable diesel engine powered equipment (diesel generators, air compressors, water pumps, etc.) with a rating of 50 HP or more, include the air permit from the BAAQMD or State registration from the California Air Resources Board (CARB). Note: diesel engine powered equipment that will be on-site for less than 72 consecutive hours does not need to include the air permit per BAAQMD Regulation 2-1-114.2.3.

For installation or retrofitting of boilers, provide specifications detailing boiler rating (units of million British thermal units per hour, MMBTU/hr), nitric oxide (NOx) and carbon monoxide (CO) air emissions, and other relevant data. Boilers rated >2 MMBTU/hr are

subject to permitting requirements per BAAQMD Regulation 2-1-114. Natural gas boilers with a rating of 10 MMBTU/hr or more need to obtain an air permit from the BAAQMD per BAAQMD Regulation 2-1-114.1. The boilers will need to go through a New Source Review and meet the requirements of BAAQMD Regulation 2, Rule 2 New Source Review. Boilers rated greater than 2 MMBTU/hr but less than 10 MMBTU/hr need to be registered with the BAAQMD per BAAQMD Regulation 9-7-404.

For projects that require the installation of abrasive blasting or sand/bead blasting equipment, include the equipment specifications detailing manufacturer and model and if the equipment has a particle collection system. Permanent abrasive blasting sources that have a confined volume of less than 100 cubic feet and are abated by a particulate filter are exempt from permitting per BAAQMD Regulation 2-1-118.1.

Hazardous Waste Disposal Subcontractors before proposed project commencement. For projects installing/modifying refrigeration systems, provide specifications detailing the refrigerant capacity of the equipment and leak detection capabilities. Refrigeration systems with a capacity or more than 50 pounds need to be registered with the State, CARB.

SD-03 Product Data

Life Cycle Assessments

Packaging

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

SD-06 Test Reports

Field Quality Control Reports

SD-07 Certificates

Environmental Regulatory Requirements

For Government's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with environmental regulations bearing on performance of the work.

Records of wastewater discharges, including dates and quantities of water discharged, daily.

Spill Cleanup Records, as necessary.

For all projects utilizing temporary equipment with a fuel tank with fuel capacity of 10 gallons or greater:

-- Capacity of fuel tank,

-- Type of fuel tank to be used (e.g., sub-base tank, etc.),

-- Type of secondary containment (must comply with Santa Clara County Hazardous Materials Storage Ordinance),

-- Type of fill point spill protection,

-- Whether or not the system has plastic tanks (plastic tanks require additional submittal of approval of Ames Fire Marshall).

Records of solvents and coatings usage with MSDSs, upon completion of project.

-- Record type of coating/solvent use, date of use and quantity.

-- For any coatings or resins that are mixed before they are applied, record the type of components and mix ratio.

Type and quantity (in pounds) of Ozone Depleting Substances (ODS) used, recovered, disposed or otherwise handled.

Site Inspection Checklists, every week for projects handling hazardous materials.

Hazardous Waste Profiles and supporting analytical data before disposal.

SD-08 Manufacturer's Instructions

Material Safety Data Sheets

Hazardous Materials Inventories Statement (HMIS) and Material Safety Data Sheets (MSDS), at project commencement and as necessary to reflect changes in materials stored.

SD-11 Closeout Submittals

Training Program

Submit two copies of instructional program outline for demonstration and training, including a schedule of dates, times, length of instruction, instructors' names, learning objective, and teaching outline for each training module. At completion of training, submit one complete training manual for Government's use, and a list of participants with each participant's results of performance-based test for each training module. For Government's records, submit Contractor 40 CFR employee training records upon request of the COR.

Protection of Natural Resources

1.6 CONTRACTOR'S ENVIRONMENTAL MANAGER

Designate an on-site Environmental Manager responsible for overseeing the environmental goals for the project and implementing procedures for environmental protection.

1.6.1 Duties

The Environmental Manager shall be responsible for the following:

a. Compliance with applicable Federal, State, and local environmental regulations, including maintaining required documentation.

b. Implementation of the Waste Management Plan.

c. Implementation of the Indoor Air Quality (IAQ) Management Plan.

d. Implementation of the Environmental Protection Plan.

e. Environmental training for Contractor personnel in accordance with their position requirements.

f. Monitoring and documentation of environmental procedures.

1.6.2 Qualifications

Minimum 5 years construction experience on projects of similar size and scope; minimum 2 years experience with environmental procedures similar to those of this project; familiarity with Environmental Management Systems (EMSs); familiarity with environmental regulations applicable to construction operations.

1.7 ENVIRONMENTAL REGULATORY REQUIREMENTS

The Contractor shall be responsible for knowing Federal, State, and local regulatory requirements pertaining to legal disposal of all construction and demolition waste materials. Comply with all applicable regulations and maintain records of permits, licenses, certificates, and other environmental regulatory requirement correspondences. The following is a list of major laws, policies and procedures, and is subject to change.

CODE OF FEDERAL REGULATIONS (CFR)

10 CFR Part 435	Energy Conservation
14 CFR Part 1216	NASA Environmental Quality Regulations
29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR 1910.1200	Hazard Communication Training
36 CFR Part 800	National Historic Preservation Act Regulations
40 CFR 82	Protection of Stratospheric Ozone
40 CFR 112	Oil Pollution Prevention
40 CFR Chapter 1 Subchapters A, D, and N	Clean Water Act (Title 33, Chapter 26 of the USC)
40 CFR Part 122 and scattered sections	National Pollutant Discharge Elimination System (NPDES)

40 CFR 1500-1508	National Environmental Policy Act
40 CFR Part 247	Comprehensive Procurement Guidelines
40 CFR 260	Hazardous Waste Management System: General
40 CFR 265.16	Generator Training
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
43 CFR Part 10	Native American Graves Protection and Repatriation Act Regulations
43 CFR 7	Protection of Archaeological Resources Regulations
49 CFR Ch. 1 (parts 100-199)	Transportation Ref Title
50 CFR Part 17	Endangered Species Act Regulations
50 CFR Part 21	Migratory Bird Treaty Act
50 CFR Part 22	Bald and Golden Eagle Protection Act
50 CFR Part 216	Marine Mammal Protection Act Regulations

CALIFORNIA CODE OF REGULATIONS (CCR)

CCR Title 13, Division 3	Motor Vehicles, Air Resources
CCR Title 14	Natural Resources
CCR Title 17, Division 3	Public Health, Air Resources
CCR Title 19	Public Safety
CCR Title 22 Section 66260, et.al.	Hazardous Waste Management
CCR Title 19, Division 1	State Fire Marshal
CCR Title 19, Division 2	Office of Emergency Services
CCR Title 19, Division 3	Seismic Safety Commission
CCR Title 19, Division 5	Earthquake Emergency and Seismic Permit Review Pane 1
CCR Title 22, Division 4.5	Environmental Health Standards for the Management of Hazardous Waste
CCR Title 23	Waters
CCR Title 24, Part 6	California's Energy Efficiency Standard
CCR Title 26	Toxics
CCR Title 27	Environmental Protection

CCR Title 22, 66265.16	Generator Training
EO 13423	Strengthening Federal Environmental, Energy, and Transportation Management
EO 13514	Federal Leadership in Environmental, Energy, and Economic Performance

UNITED STATES CODES (USC)

16 USC 469	National Historic Preservation Action Amendments of 1980
16 USC 470	National Historic Preservation Act of 1966, as amended
16 USC 470aa-470mm	Archaeological Resources Protection Act
16 USC Chapt. 31, 1361 et seq.	Marine Mammal Protection Act
16 USC 668-668d	Bald and Golden Eagle Protection Act
16 USC 703-712	Migratory Bird Treaty Act
16 USC 1531-1544	Endangered Species Act
25 USC 3001-3013	Native American Graves - Protection
33 USC 1251 et seq.	Clean Water Act
33 USC 2701 et seq.	Oil Pollution Act
42 USC 4371 et seq.	National Environmental Policy Act
42 USC 6901-6992	Resource Conservation and Recovery Act
42 USC 7401 et seq.	Clean Air Act
42 USC 8251 et seq.	National Energy Conservation Policy Act, Part B/Federal Energy Management
42 USC 9601 et seq.	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
42 USC 13101- 13109	Pollution Prevention Act of 1990

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD, GENERAL NPDES PERMITS

CAS000001	Industrial Storm Water Discharges
CAS000002	Construction Storm Water Discharges
CAS000004	Small Municipal Separate Storm Sewer Systems
CAG912003	Discharge or Reuse of Extracted and Treated Groundwater

BAY AREA AIR QUALITY MANAGEMENT DISTRICT RULES AND REGULATIONS, AIR QUALITY (BAAQMD)

BAAQMD Regulations 1-12	General
BAAQMD Regulation 2, Rule 1	General Requirements
BAAQMD Regulation 8, Rule 3	Architectural Coatings
BAAQMD Regulation 8, Rule 49	Aerosol Paint Products
BAAQMD Regulation 8, Rule 51	Adhesive and Sealant Products
BAAQMD Regulation 9, Rule, 6	Natural Gas-Fired Boilers and Water heaters (Boilers rated 0-2 MMBTU/hr)
BAAQMD Regulation 9, Rule 7	Boilers (Boilers rated >2 MMBTU/hr
BAAQMD Regulation 11, Rules 1 & 2	Asbestos
BAAQMD Regulation 12, Rule 3	Asphalt Air Blowing
BAAQMD Regulation 12, Rule 4	Sandblasting

SANTA CLARA COUNTY

Sunnyvale Municipal Code 12	City of Sunnyvale Waters and Sewer Ordinance
Palo Alto Chapter 16	City of Palo Alto Sewer Use Ordinance
SCC ordinance Code B11	Santa Clara County Hazardous Materials and Toxic Gas Storage and Permitting

NASA POLICY AND PLANS AND EXECUTIVE ORDERS

APD 8500.1	Ames Environmental Policy
APR 8500.1	Ames Environmental Procedural Requirements
APR 8553.1	Ames Environmental Management System(incorporating by reference Environmental Work Instructions (http://environmentalmanagement.arc.nasa.gov/ems/index.h
NPD 8500.1	NASA Environmental Management
NPR 8553.1	NASA Environmental Management Systems
NPR 8580.1	NASA Procedural Requirements for Implementing the National Environmental Policy Act and Executive Order 12114
SWPPP and BMPs	Storm Water Pollution Prevention Plan and Best Management Practices
SPCC	Spill Prevention, Control and Countermeasures Plan

ESL	(2008) California Regional Water Quality Control Board, Region IX, Environmental Screening Levels
EPA RSL	(2011) U.S. Environmental Protection Agency, Region IX, Regional Screening Levels Table
SSPP	NASA Strategic Sustainability Performance Plan
Records of Decision	(2002) NASA Ames Development Plan Programmatic Environmental Impact Statement and Record of Decision
	(1989) USEPA Record of Decision for the MEW Study Area (Ground Water Contamination)
	(2010) USEPA Record of Decision Amendment for the Vapor Intrusion Pathway

1.8 ENVIRONMENTAL REQUIREMENTS FOR PRODUCTS

1.8.1 Material Safety Data Sheets (MSDS)

Submit an MSDS for each product specified in other sections or required by OSHA to have an MSDS. MSDS shall be prepared within the previous five years. Include information for MSDS Sections 1 through 16 in accordance with ANSI Z400.1/Z129.1 and 29 CFR 1910.1200 Appendix D.

In addition to the MSDS, provide the additional information:

a. Include data used to determine the hazards cited in Section 3. Identify acute data, carcinogenicity, reproductive effects, and target organ effects. Provide written description of the process used in evaluating chemical hazards relative to preparation of the MSDS.

b. Include data regarding the proper disposal of the chemical, including the disposal of any contaminated packaging. Include information regarding recycling and reuse. Indicate whether or not the product is considered to be "hazardous waste" according to 40 CFR 261.

c. Identify Federal, State, and local regulations applicable to the material.

d. Include additional information relative to recycled content, biobased content, and other information regarding environmental and health impacts. Identify the date MSDS was prepared.

1.8.2 Life Cycle Assessments (LCAs)

For the following products, submit LCA data developed in accordance with ISO 14040; and where BEES data exists, submit NIST BEES 4.0 analysis using 100 percent Environmental Performance Weighting and the EPA Scientific Advisory Board Environmental Impact Category Weights.

a. Masonry

b. Finish Carpentry

c. Plastic Fabrications

d. Building Insulation

e. Roofing

f. Joint Sealers

g. Wood & Plastic Doors

h. Windows

i. Skylights

j. Glazed Curtain Wall

k. Gypsum Board

l. Tile

m. Acoustical Ceilings

n. Resilient Flooring

o. Carpet

p. Toilet Compartments

q. Loading Dock Equipment

r. Office Equipment

s. Furnishings & Accessories

t. Renewable Energy Equipment

u. Elevators

v. HVAC equipment

x. Lighting equipment

1.9 ENVIRONMENTAL PROTECTION PLAN

Prepare and submit an Environmental Protection Plan not less than 10 days before the preconstruction meeting. At a minimum, address the following elements in accordance with this section:

a. Identification and contact information for Environmental Manager.

b. General site information, including preconstruction description and photographs.

c. Summary of training program.

d. Procedures to address water resources.

e. Procedures to address land resources.

f. Procedures to address air resources.

g. Procedures to address fish, wildlife and plant (and their habitats)resources.

h. Procedures to address cultural resources.

i. Monitoring and quality control procedures.

Procedures to avoid interfering with remediation activities or creating new pathways.

Revise and resubmit Plan as required by the COR. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.

1.10 ENVIRONMENTAL DEMONSTRATION AND TRAINING

Contractor shall provide environmental training for workers performing work on the project site.

1.10.1 Instructor Qualifications

Training shall be given by a firm or individual experienced in providing training or education similar in content and extent to that indicated for this project.

1.10.2 Coordination

Coordinate instruction schedule with Government operations. Adjust schedule as required to minimize disruption of Government operations. Coordinate instruction with demonstration and training of general building systems.

1.10.3 Training Program

Develop a training program for all site workers that includes the following topics:

a. Overview of environmental and sustainability issues related to the building industry.

b. Overview of environmental and sustainability issues related to the project.

c. Compliance with applicable Federal, State, and local environmental regulations.

d. Review of site specific procedures and management plans implemented during construction, including the Waste Management Plan, Indoor Air Quality (IAQ) Management Plan, Environmental Protection Plan, and procedures for noise and acoustics management.

e. All personnel shall be trained in the hazards and safe work practices for their tasks.

f. Personnel performing hazardous operations shall receive training as specified in applicable regulations.

1. Personnel handling hazardous materials shall have received Hazard Communication Training per 29 CFR 1910.1200 and CCR Title 8 Section 5194 and Emergency Response Awareness Level training per 29 CFR 1910.120. Employee training documents shall be kept at the jobsite.

2. Personnel containing spills or conducting cleanup of small spills shall have received First Responder Operations level training per 29 CFR 1910.120.

3. Personnel generating hazardous waste shall receive training on the proper management of hazardous waste per 40 CFR 265.16 and CFR Title 22 Section 265.16.

4. Personnel using personal protective equipment (PPE) shall receive training on its proper use per 29 CFR 1910.132.

5. Personnel involved with hazardous materials and hazardous waste preparation for shipment shall receive training as hazmat employees per 49 CFR 172.704(c)(2).

g. Personnel handling hazardous materials shall have received Hazard Communication Training per 29 CFR 1910.1200 and CCR Title 8 Section 5194 and Emergency Response Awareness Level training per 29 CFR 1910.120. Employee training documents shall be kept at the jobsite.

h. Personnel containing spills or conducting cleanup of small spills shall have received First Responder Operators level training per 29 CFR 1910.120.

i. Personnel generating hazardous waste shall have received training on the proper management of hazardous waste per 40 CFR 66265.16 and CFR Title 22 Section 66265.16.

j. All Contractor personnel involved in operations with potential to impact storm water quality or the storm drain system shall have awareness training regarding the project specific SWPPP and the applicable BMPs. Documentation of this training shall be provided to the Government.

k. Personnel operating in wildlife habitats, where operations may be affected by wildlife, or who may come in contact with wildlife shall have wildlife awareness training relevant to this project.

l. Personnel operating in or whose operations may affect cultural resources shall have awareness training relevant to the project.

m. Personnel shall have awareness training of the NASA Ames Environmental Management System, including high priority risks (air, hazmat, energy, water).

1.10.3.1 Scheduling

Provide instruction at mutually agreeable times.

1.10.3.2 Training Modules

Develop a learning objective and teaching outline for each topic in the

Training Program. Include a description of specific skills and knowledge that each participant is expected to acquire. Instructors shall be well-versed in the particular topics that they are presenting.

1.10.3.3 Evaluation

At the conclusion of each training module, assess and document each participant's understanding of the module by use of a written performance-based test.

PART 2 PRODUCTS

2.1 ENVIRONMENTALLY PREFERABLE PRODUCTS

Consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and disposal of products, and provide products and materials with the least effect on the environment, determined by LCA analysis, released toxins, and other methods.

a. All products purchased for Federal projects with Federal funds, including contractors, are required by EO 13423 and Part 23 of the Federal Acquisition Regulations (FAR) to assess and give preference to those products and services that are environmentally preferable. Environmentally preferable products are of recycled content, recyclable, of low toxicity, reusable, locally produced, low-polluting, have long life cycles, are harvested on a sustained yield basis, and are biobased.

b. In addition, EO 13423 and RCRA 6002 require the U.S. EPA and USDA to maintain the Comprehensive Procurement Guidelines (CPG) and BioPreferred Program, which are lists of products and materials that MUST be purchased at the maximum recycled-content level specified. CPG items include: building insulation, carpet, carpet cushion, cement, concrete, latex paint, floor tiles, flowable fill, laminated paperboard, modular threshold ramps, non-pressure pipe, patio blocks, roofing materials, shower and restroom dividers/partitions, plastic lumber landscaping timbers and posts, plastic fencing, playground equipment, playground surfaces, blasting grit, industrial drums, manual grade strapping, mats, pallets, signage, bike racks, and structural fiberboard. BioPreferred product categories include: roof coatings, composite panels, fluid- filled transformers, plastic insulating foam, carpets, greases, hydraulic fluids, metal working fluids, wood and concrete sealers, concrete and asphalt release fluids, erosion control materials, and interior paints and coatings.

c. If using Federal funds, including contractors, and purchasing one of these products, the product must be purchased at the highest recycled content level practicable.

d. The complete up-to-date list of CPG products and required recycled content levels is available at http://www.epa.gov/cpg/. The list of USDA BioPreferred program product categories and the minimum biobased content standards established for each category is at http://www.biopreferred.gov/ProposedAndFinalItemDesignations.aspx.

e. If this product is unacceptable based on quality, availability, or cost, a waiver must be submitted to and approved by the Environmental Management Division. The COR will provide form ARC 813 to the contractor when required. More information is available at http://

environmentalmanagement.arc.nasa.gov/forms/.

f. For guidance on finding specific products that meet these requirements, please contact the Environmental Management Division.

2.1.1 Prohibited Materials

The use of the following materials is prohibited:

a. Products containing asbestos.

b. Products containing urea formaldehyde.

c. Products containing polychlorinated biphenyls.

d. Products containing chlorinated fluorocarbons.

e. Solder or flux containing more than 0.2 percent lead and domestic water pipe or pipe fittings containing more than 8 percent lead.

f. Paint containing more than 0.06 percent lead.

2.1.2 Packaging

Where Contractor has the option to provide one of the listed products or equal, preference shall be given to products with minimal packaging and easily recyclable packaging, and to manufacturers with policies that take back product packaging.

2.1.2.1 Industrial Paperboard

Minimum 100 percent post-consumer recycled content in accordance with ASTM D 5663.

2.1.2.2 Carrier Board

Minimum 100 percent recycled content with a minimum of 15 percent post-consumer recycled content in accordance with ASTM D 5663.

2.1.2.3 Brown Papers

Minimum 40 percent recycled content with a minimum of 20 percent post-consumer recycled content in accordance with ASTM D 5663.

2.1.3 Substitutions

Notify the COR when Contractor is aware of materials, equipment, or products that meet the aesthetic and programmatic intent of Contract Documents, but which are more environmentally responsible than materials, equipment, or products specified or indicated in the Contract Documents. Submit the following for initial review by the COR:

a. Product data including manufacturer's name, address, and phone number.

b. Description of environmental advantages of proposed substitution over specified product.

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Comply with applicable regulations and these specifications. Preserve the natural resources within the project boundaries and outside the limits of permanent work performed under this Contract in their existing condition or restore to an equivalent or improved condition as approved by the COR. Where violation of environmental procedures requirements will irreversibly damage the site, the Contractor shall immediately contact the COR and CO to coordinate with the NASA Ames Environmental Management Division to develop a mitigation strategy and, if necessary, report to regulatory agencies.

3.1.1 General Disturbance

Confine demolition and construction activities to work area limits indicated on the Drawings. Remove debris, rubbish, and other waste materials resulting from demolition and construction operations from site. Transport materials with appropriate vehicles and dispose of them off site to areas that are approved for disposal by governing authorities having jurisdiction. Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways. Remove spillage and sweep, wash, or otherwise clean project site, streets, or highways. Burning is prohibited.

3.1.2 Water Resources

Comply with requirements of the NPDES and the applicable State Pollutant Discharge Elimination System (SPDES). Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water. Store and service construction equipment at areas designated for collection of oil wastes. Prevent ponding of stagnant water conducive to mosquito breeding habitat. Prevent run-off from site during demolition and construction operations. Equipment will be permitted to ford live streams if temporary culverts or bridges are constructed for the purpose and the CO and COR have obtained approval from the NASA Ames Environmental Management Division that the action will not violate wetlands or wildlife laws, regulations and policies, such as those covering steelhead salmon, western pond turtle, salt marsh harvest mouse, and protected birds. Remove temporary culverts and bridges upon completion of work and repair the area to its original condition, unless otherwise accepted in writing by the COR.

3.1.2.1 Wastewater Discharge Permits

a. In accordance with the Clean Water Act, the City of Sunnyvale Water and Sewers Ordinance, and the City of Palo Alto Sewer Use Ordinance, a specific written Incidental Sewer Discharge permit is required before discharging wastewaters to the sanitary sewer system from project activities such as excavation dewatering, saw cutting coolant water, cleaning operations, and decontamination water.

b. The Contractor shall complete and submit a Request for Incidental Sewer Discharge form to the COR at least 7 work days before the planned discharge of groundwater or other wastewater. The request shall include the estimated discharge volume, discharge rate, source of the wastewater and the duration of discharge. The Government will sample the wastewater and obtain the discharge approval.

c. Wastewater Discharge

1. With the exception of groundwater from excavation, wastewater from Contractor operations shall be containerized by the Contractor until the Contractor is notified a discharge permit has been obtained.

2. The Contractor shall record and submit information specified in the discharge permit issued to the project including, but not limited to, the dates of discharge, quantity of water discharged, source of the wastewater, dates wastewater was sampled and analyzed (if required), and filtering method (if required).

3. Non-sewerable wastewater shall be disposed of by the Government in accordance with subsection 3.1.8.1, Government Disposal.

4. Non-sewerable wastewater shall be treated, managed, and disposed of properly by the Contractor in accordance with subsection 3.1.8.2, Contractor Disposal.

d. In the event that the POTW requires a Groundwater Discharge Permit, the Contractor will coordinate with the Environmental Management Division to complete the application. This may take 2-4 weeks. The Environmental Management Division must submit the completed application, along with all fees, and receive the approved permit prior to any discharge of any groundwater.

3.1.2.2 Storm Water Management

a. All development or redevelopment with a footprint that exceeds 5,000 square feet shall be in accord with the Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act, which states that "the sponsor . . . shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."

b. Site Inspections - In accordance with Santa Clara County Hazardous Materials Storage Ordinance No. NS-517.31 the project site and all hazardous materials storage areas shall be inspected weekly by the Government to ensure compliance. In accordance with the project specific Storm Water Pollution Prevention Plan (SWPPP), the Government shall conduct inspections prior to any forecasted storm event, every 24 hour period during extended rain events and after every storm event to ensure required Best Management Practices (BMPs) were implemented and remained effective.

c. Hazardous Materials Storage

1. Hazardous materials storage shall be in accordance with Santa Clara County Hazardous Materials Storage Ordinance No. NS-517.31, and the General Storm Water Permit. Hazardous materials shall be handled in manner that minimizes the potential for releases. All liquid hazardous materials must be secondarily contained. Adequate spill response equipment shall be readily available.

2. Hazardous materials and hazardous wastes shall be labeled, handled properly, and stored in watertight containers with appropriate

secondary containment. Secondary containment shall be of adequate size and compatible with the materials stored. Storage areas shall be properly labeled and secured.

d. Staging Area - In accordance with the Clean Water Act and Ames SWPPP, to the maximum extent practicable, the staging area must be located away from storm drain inlets, gutters, drainage ditches, storm drain inlets, and creeks.

e. Granular Material Storage - In accordance with the Clean Water Act and Ames SWPPP, granular material shall be stored at least 10 ft from drainage ditches, catch basins, and curbs.

f. Refuse Bins - Refuse bins shall not be overloaded. Liquid materials shall not be placed in dumpsters or bins. Leaking dumpsters shall be replaced. Dumpsters and bins shall not be cleaned on-site. Dumpsters and bins shall be kept closed except when loading or emptying. Waste disposal containers shall be covered at the end of every business day and during a rain event. Dumpsters shall be wildlife resistant (per NADRPEIS and ROD 2002)

g. Landscaping - The Contractor shall control soil erosion and storm run-off to protect natural habitat from the project site to the satisfaction of the COR.

h. Stockpiles - All loose stockpiled construction materials that are not actively being used (soil, spoils, aggregate, fly-ash, stucco, hydrated lime, etc.) shall be covered and bermed.

i. Site Operations - shall be conducted in accordance with the Clean Water Act and Ames SWPPP.

j. Equipment Fueling and Maintenance - In accordance with the applicable BMP, equipment fluid changes and fueling shall be conducted over drip pans to prevent spilled materials from contacting the ground surface. The operator of leaking equipment shall contain and control the leak. All other maintenance and repairs of Contractor equipment is prohibited on-site.

k. Paint Clean-up

1. Painting operations must be conducted in accordance with Ames SWPPP and applicable BAAQMD requirements.

2. Water Based Paints

a) The Contractor shall paint out as much excess paint as possible from brushes, rollers, and equipment before starting clean up. Rinse brushes, rollers, and other tools over a sink that drains to the sanitary sewer using water only. Tools and equipment shall not be cleaned into streets, gutters, storm drains, or creeks. Dispose of dry brushes, rollers, rags, and drop cloths as solid waste.

b) Disposal of containers with any liquids as a solid waste is prohibited. These materials must be used elsewhere or handled as a hazardous waste and disposed of in accordance with subsection 3.1.8.2, Contractor Disposal.

3. Oil Based Paints

a) The Contractor shall paint out as much excess paint as possible from brushes, rollers, and equipment before starting clean up. Cleaning wash water shall be containerized and disposed of as hazardous waste. Reuse thinners and solvents by pouring back into original container through a filter.

b) Dispose of waste thinners, solvents, paint sludge, and wash water from cleaning of equipment and tools as hazardous waste. Containers with residual product shall be managed as a hazardous waste and disposed of in accordance with subsection 3.1.8.2, Contractor Disposal.

l. Paving Operations

1. Catch basins and manholes shall be protected when paving or applying seal coat, tack coat, slurry seal, or fog seal. Sweeping or washing down excess sand (from applying sand seals or covering excess oil) into gutters, storm drains, or creeks is prohibited. Excess materials shall either be collected and returned to the stockpile or disposed of properly.

2. Paving operations shall not obscure existing utility boxes, ground water monitoring wells, manholes, valve boxes or similar features. Notify the COR of any features potentially impacted.

m. Concrete/Asphalt Cutting and Core Drilling - In accordance with the applicable BMP, the Contractor shall not allow slurry run-off from saw cutting or core drilling to enter the storm or sanitary sewer collection systems. Catch basins and drains shall be protected. The Contractor shall sweep/shovel up slurry cutting waste from work areas before leaving an area or at the end of each work day, whichever is sooner. If saw-cut slurry enters a drain, the Contractor shall remove the slurry and notify the COR immediately.

n. Concrete Truck/Wash Out - In accordance with the applicable BMP, washing out concrete trucks or equipment into streets, gutters, storm drains, or creeks is prohibited. Trucks may be washed out on the ground surface in a location approved by the COR.

o. Sweeping - Roadways and on-site paved areas impacted by the project shall be cleaned as necessary to the satisfaction of the COR and swept at the end of each workday, prior to forecasted rain, at the end of each phase and at project completion. Hosing down paved areas and streets is prohibited.

p. Reclaimed Water - The Contractor shall use reclaimed water for dust control and other construction site operations unless an exception is granted by the COR. Reclaimed water is available at no cost from a hydrant located on Moffett Federal Airfield approximately 328 ft south of the intersection of Macon Road and Fifth Avenue.

q. Storm Drain Management

1. In accordance with the applicable BMP, catch basins near the project shall be protected to prevent debris, pollutants, sediments and releases from entering the storm drain system. Catch basins shall be inspected and cleaned out to the satisfaction of

the COR at the end of each phase or at project completion.

2. In accordance with the applicable BMP, the Contractor shall control soil erosion and storm runoff from the Contractor's site to the satisfaction of the COR.

r. Broken/Ruptured Pipes - If the Contractor breaks a utility pipe, or observes any broken or leaking pipes, it shall immediately notify the COR. The Contractor shall immediately notify Ames Environmental Management Division if the pipe contained any liquid except potable water. The Contractor shall berm the area to prevent run-off from releases of non-potable water from entering the storm drain.

s. Draining, Tanks, Piping, and Equipment

1. Tanks, piping, and equipment shall be drained as required. Devices to properly contain the product shall be provided by the Contractor. Storm drains in the vicinity shall be covered during drainage operations.

2. The Government will conduct the sampling of drained fluid in order to determine disposal options unless there is sufficient generator knowledge to determine disposal options.

3. The Government will obtain the necessary sanitary sewer discharge permits if the discharge is sewerable. Non-sewerable water shall be treated to a level to allow discharge to the sanitary sewer or managed and disposed of properly.

4. Disposal of drained fluid and associated costs shall be by the Government in accordance with subsection 3.1.8.1, Government Disposal.

t. Authorized Non-Storm Water Discharges

1. Following is a list of authorized non-storm water discharges:

a) Atmospheric condensate including refrigeration, air conditioning and compressor condensate.

b) Irrigation drainage and landscape watering.

c) Uncontaminated ground water provided that the water does not become contaminated with soil or sediment (muddy).

d) Water from fire hydrant flushing or testing.

e) Water from fire fighting activities.

2. To the extent practicable, authorized non-storm water discharges shall be minimized. Additionally, the Environmental Management Division shall be notified of all authorized non-storm water discharges so that they may be observed and/or documented as required by the General Storm Water Permits.

3.1.2.3 Spill Prevention, Control, and Reporting

a. All liquid petroleum products must be secondarily contained in accordance with Ames Spill Prevention Control and Countermeasures Plan

and 40 CFR 112, spill clean-up materials (such as rags, absorbent booms/pads), and tools (such as shovels and brooms) shall be maintained at the project site and be readily accessible. Releases of hazardous materials to the environment shall be contained and measures implemented to prevent leaks and spills from entering storm drains. Spills of hazardous materials to unpaved surfaces in excess of 1 ounce shall immediately be reported to Environmental Management Division.

b. Dial 911 from any NASA phone or 650-604-5555 from an outside phone to request assistance of any spill by the Contractor.

3.1.2.4 Drinking Water Resources

Any proposed drinking water well must be coordinated with the Ames Remediation Program Manager, who is the only person authorized to sign well permit applications on behalf of NASA as the landowner before applications are submitted to the Santa Clara County Water District. Under no circumstances may a drinking water well be placed in a location that has not been cleaned up to residential standards, e.g., capped landfills, petroleum sites, or in a location that would otherwise interfere with on-going remediation activities.

3.1.3 Land Resources

Prior to construction, identify land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and landforms without permission from the COR. Coordinate protection practices with work specified in Division 2 EXISTING CONDITIONS.

a. Construction Over Or In MEW Study Area

1. Any construction over or in the area of shallow groundwater contamination known as the MEW Study Area must implement the remedy prescribed in the Record of Decision for the Middlefield/Ellis/Whisman (MEW) Study Area and Record of Decision Amendment for the Vapor Intrusion Pathway and be coordinated with the Ames Environmental Management Division Remediation Program Manager.

2. Soil boring and well data shall be transmitted to the Ames Remediation Program Manager.

3. The Contractor shall follow procedures outlined in Section 02 61 13. This section can be detained from the COR, if needed.

b. Contaminated Soil Management

1. The Contractor shall notify the COR immediately if soil appears discolored or has an odor. The Contractor shall place suspect soil on plastic sheeting and cover with a plastic tarpaulin. The suspect soil will be tested by the Government for contamination.

2. Contaminated soil shall be transferred to a designated on-site location for disposal by the Government in accordance with subsection 3.1.8.1, Government Disposal or properly disposed of by the contractor in accordance with subsection 3.1.8.2, Contractor Disposal.

c. Construction Over or In Landfill Sites and Petroleum Contaminated Sites

Any construction over or in the vicinity of former landfill sites, petroleum contaminated sites, treatment systems and other remediation activities, must be coordinated with the Ames Environmental Management Division Remediation Program Manager for consistency with CERCLA, RCRA, and TSCA decision documents issued by the U.S. Environmental Protection Agency, Regional Water Quality Control Board, and California Department of Toxic Substances Control. In no case shall residential construction be authorized where the sites have not been cleaned up to residential standards.

d. Construction, Removal, or Modification of Wells

Any request to construct, remove, or modify a well, including, e.g., drinking water wells, geothermal wells, monitoring wells, must be coordinated with the Ames Environmental Management Division Remediation Program Manager for consistency with CERCLA, RCRA, and TSCA decision documents issued by the U.S. Environmental Protection Agency, Regional Water Quality Control Board, and California Department of Toxic Substances Control. Only the Ames RPM is authorized to sign well permit applications on behalf of NASA as the landowner prior to submittal to the Santa Clara County Water District for approval. In no case shall drinking water well permit applications be authorized by NASA where the sites have not been cleaned up to residential standards.

3.1.3.1 Erodible Soils

Plan and conduct earthwork to minimize the duration of exposure of unprotected soils, except where the constructed feature obscures borrow areas, quarries, and waste material areas. Clear areas in reasonably sized increments only as needed to use the areas developed. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.

3.1.3.2 Erosion and Sedimentation Control Devices

Construct or install temporary and permanent erosion and sedimentation control features as required.

3.1.3.3 Tree and Plant Protection

Protect as specified in Division 2 EXISTING CONDITIONS and as specified. Prior to start of construction, tag each tree and plant scheduled to remain. In the event of damage to tree or plant, the Government may, at the COR's discretion, deduct the indicated value of the damaged tree or plant from the Contract Sum.

3.1.3.4 Drinking Water Sources

Any proposed drinking water well must be coordinated with Ames Remediation Program Manager, who is the only person authorized to sign well permit applications on behalf of NASA as the landowner before applications are submitted to the Santa Clara County Water District. Under no circumstances may a drinking water well be placed in a location that has not been cleaned up to residential standards, e.g., capped landfills, petroleum sties, or in a location that would otherwise interfere with on-going remediation activities.

3.1.4 Air Resources

Comply with Indoor Air Quality (IAQ) Management Plan and as follows:

a. Prevent creation of dust, air pollution, and odors.

b. Sequence construction to avoid unnecessary disturbance to site.

c. Use mulch, water sprinkling, temporary enclosures, and other appropriate methods as needed to limit dust and dirt rising and scattering in air. Do not use water when it may create hazardous or other adverse conditions such as flooding and pollution.

d. Store volatile liquids, including fuels and solvents, in closed containers. Do not store with materials that have a high capacity to adsorb VOC emissions or in occupied spaces.

e. Properly maintain equipment to reduce gaseous pollutant emissions.

f. Construction operations and materials used on the project shall be in compliance with the Rules and Regulations for Air Quality of the Bay Area Air Quality Management District (BAAQMD).

g. If coatings are used, the coatings need to meet the VOC requirements of the BAAQMD Regulations. The VOC requirements vary depending on the coating operation. For architectural coatings, follow the requirements of BAAQMD Regulation 8, Rule 3. For surface coating of miscellaneous metal parts and products, follow the requirements of BBAQMD Regulation 8, Rule 49. For adhesive and sealant products, follow the requirements of BAAQMD Regulation 8, Rule 51. the VOC content can be found on the coating's MSDS. The VOC normally is listed in the section listing the physical and chemical properties of the coating. General assistance is always available from the Environmental Management Division to ensure compliance with BAAQMD coating regulations.

h. Aerospace Coatings - Aerospace coatings shall conform to BAAQMD Regulation 8, Rule 29 for VOC content limits.

i. Architectural Coatings - Architectural coatings and paints shall conform to BAAQMD Regulation 8, Rule 3 for VOC content - Architectural Coating Limits.

j. Spray Paints - Spray paints shall conform to BAAQMD Regulation 8, Rule 49 for VOC content - Aerosol Coatings.

k. Chlorofluorocarbons (CFCs) and Other Class I Ozone Depleting Substances.

   1. Class I Ozone Depleting Substances (ODS) as defined and identified herein shall not be used in the performance of this contract, nor be provided as part of the equipment. This prohibition shall prevail over any other provision, specification, drawing, or referenced documents.

   2. Class I ODS is defined in Section 602(a) of the Clean Air Act and includes the following chemicals:

      a) Chlorofluorocarbon-11 (CFC-11)
      b) Chlorofluorocarbon-12 (CFC-12)

c) Chlorofluorocarbon-13 (CFC-13)
d) Chlorofluorocarbon-111 (CFC-111)
e) Chlorofluorocarbon-112 (CFC-112)
f) Chlorofluorocarbon-113 (CFC-113)
g) Chlorofluorocarbon-114 (CFC-114)
h) Chlorofluorocarbon-115 (CFC-115)
i) Chlorofluorocarbon-211 (CFC-211)
j) Chlorofluorocarbon-212 (CFC-212)
k) Chlorofluorocarbon-213 (CFC-213)
l) Chlorofluorocarbon-214 (CFC-214)
m) Chlorofluorocarbon-215 (CFC-215)
n) Chlorofluorocarbon-216 (CFC-216)
o) Chlorofluorocarbon-217 (CFC-217)
p) Halon-1211
q) Halon-1301
r) Halon-2402
s) Carbon tetrachloride
t) Methyl chloroform

3. Service, maintain, renovate, and demolish ODS containing equipment in accordance with 40 CFR 82. Prevent a discharge of ODS to the atmosphere. ODS recovery equipment shall be certified by an EPA-approved equipment testing organization. Place recovered ODS in cylinders suitable for the type of ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. For new ODS added to existing equipment, provide the following data to the Environmental Management Division, Mail Stop 237-14, within 48 hours of adding the new ODS: equipment manufacturer and model number, location, type of ODS, quantity added, and date the work was performed.

4. The Contractor shall ensure that CFC refrigerants are recovered by a certified technician in accordance with the Final Rule of the Clean Air Act of 1990, Section 608, before the equipment is removed from Government property. Keep copies of technician certification at the technician's place of business.

5. In accordance with §82.3 of Section 608 of the CAA, recovered ODS for destruction must be shipped to a destruction facility which uses one of the following destruction technologies: liquid injection incineration, reactor cracking, gaseous/fume oxidation, rotary kiln incineration, cement kiln, or radio frequency plasma; recovered ODS for reclamation must be sent to an EPA-certified refrigerant reclaimer. A list can be viewed at: http://www.epa.gov/ozone/ partnerships/rad/radpartners.html.

l. Hydrochlorofluorocarbons (HCFCs) and Other Class II Ozone Depleting Substances.

1. Class II Ozone Depleting Substances (ODS) as defined and identified herein shall not be used in the performance of this contract, nor be provided as part of the equipment. This prohibition shall prevail over any other provision, specification, drawing, or referenced documents. Refer to the EPA Significant New Alternatives Policy (SNAP) Program for a listing of acceptable ODS substitutes by sector found at http://www.epa.gov/ozone/snap/lists/index.html.

2. Class II ODS is defined in Section 602(b) of the Clean Air Act and

includes the following chemicals:

a) hydrochlorofluorocarbon-21 (HCFC-21)
b) hydrochlorofluorocarbon-22 (HCFC-22)
c) hydrochlorofluorocarbon-31 (HCFC-31)
d) hydrochlorofluorocarbon-121 (HCFC-121)
e) hydrochlorofluorocarbon-122 (HCFC-122)
f) hydrochlorofluorocarbon-123 (HCFC-123)
g) hydrochlorofluorocarbon-124 (HCFC-124)
h) hydrochlorofluorocarbon-131 (HCFC-131)
i) hydrochlorofluorocarbon-132 (HCFC-132)
j) hydrochlorofluorocarbon-133 (HCFC-133)
k) hydrochlorofluorocarbon-141 (HCFC-141)
l) hydrochlorofluorocarbon-142 (HCFC-142)
m) hydrochlorofluorocarbon-221 (HCFC-221)
n) hydrochlorofluorocarbon-222 (HCFC-222)
o) hydrochlorofluorocarbon-223 (HCFC-223)
p) hydrochlorofluorocarbon-224 (HCFC-224)
q) hydrochlorofluorocarbon-225 (HCFC-225)
r) hydrochlorofluorocarbon-226 (HCFC-226)
s) hydrochlorofluorocarbon-231 (HCFC-231)
t) hydrochlorofluorocarbon-232 (HCFC-232)
u) hydrochlorofluorocarbon-233 (HCFC-233)
v) hydrochlorofluorocarbon-234 (HCFC-234)
w) hydrochlorofluorocarbon-235 (HCFC-235)
x) hydrochlorofluorocarbon-241 (HCFC-241)
y) hydrochlorofluorocarbon-242 (HCFC-242)
z) hydrochlorofluorocarbon-243 (HCFC-243)
aa) hydrochlorofluorocarbon-244 (HCFC-244)
bb) hydrochlorofluorocarbon-251 (HCFC-251)
cc) hydrochlorofluorocarbon-252 (HCFC-252)
dd) hydrochlorofluorocarbon-253 (HCFC-253)
ee) hydrochlorofluorocarbon-261 (HCFC-261)
ff) hydrochlorofluorocarbon-262 (HCFC-262)
gg) hydrochlorofluorocarbon-271 (HCFC-271)

3. Service, maintain, renovate, and demolish ODS containing equipment in accordance with 40 CFR 82. Prevent a discharge of ODS to the atmosphere. ODS recovery equipment must be certified by an EPA-approved equipment testing organization. Place recovered ODS in cylinders suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. For new ODS added to existing equipment, provide the following data to the Environmental Management Division, Mail Stop 237-14, within 48 hours of adding the new ODS: equipment manufacturer and model number, location, type of ODS, quantity added, and date the work was performed.

4. The Contractor shall ensure that HCFC refrigerants are recovered by a certified technician in accordance with the Final Rule of the Clean Air Act of 1990, Section 608, before the equipment is removed from Government property. Keep copies of technician certification at the technician's place of business.

5. In accordance with §82.3 of Section 608 of the CAA, recovered ODS for destruction must be shipped to a destruction facility which uses one of the following destruction technologies: liquid injection incineration, reactor cracking, gaseous/fume oxidation, rotary kiln incineration, cement kiln, or radio frequency plasma;

recovered ODS for reclamation must be sent to an EPA-certified refrigerant reclaimer. A list can be viewed at http://www.epa.gov/ozone/ partnerships/rad/radpartners.html.

m. Reduce indoor levels of radon gas and formaldehyde emissions by following industry and U.S. EPA guidelines on indoor environmental quality (see http://www.epa.gov/iaq for more information).

The Contractor is responsible for meeting the State and CARB requirements for both the off-road and on-road vehicle regulations.

Use of sulfur hexafluoride (SF6) is restricted to gas insulated switchgear equipment and some research and development activities. Contact the Environmental Management Division, Code JQ, before bringing any SF6 containing equipment on-site.

Refrigeration systems with a full charge greater than 50 pounds of high-GWP refrigerant, must meet the requirements of the CARB regulation for the management of high global warming potential refrigerants for stationary sources (California Code of Regulations Title 17 Subarticle 5.1 Sections 95380 to 95398.

The Contractor shall provide information (construction schedule, construction equipment fleet emissions information, etc.) to the Environmental Management Division to calculate construction related emissions. The COR and the Contractor shall coordinate construction activities to ensure that the NASA Ames overall emission of ozone precursor compounds associated with project construction and operation do not exceed a cumulative total of 100 tones per year.

The Contractor shall use mitigation measures to reduce nitrogen oxides (NOx) emission from construction activities. The Contractor shall reduce unnecessary idling of construction equipment and follow NASA Ames idling guidelines for diesel power equipment. All construction equipment is prohibited from idling more than 5 minutes. The Contractor shall properly maintain construction equipment.

The staging of three or more pieces of construction equipment near or just upwind from sensitive receptors, such as residences or daycare uses, is prohibited.

3.1.5 Fish, Wildlife, Plant Resources, and Habitat

Manage and control construction activities to minimize interference with and damage to fish and wildlife and plants and habitat. Do not disturb fish and wildlife. Do not alter water flows or otherwise significantly disturb the native habitat related to the project and critical to the survival of fish and wildlife, and protected plants except as indicated or specified. Do not introduce non-native species. Contact Ames Facilities Maintenance for assistance in control of common pests, such as rats, bees, fleas, and the EMD for assistance in managing wildlife concerns.

3.1.5.1 Burrowing Owl Habitat

a. The Contractor shall conduct its activities in a manner that does not negatively impact fauna or flora, in accordance with 40 CFR 1500, 50 CFR 402, and Ames Environmental Procedural Requirement, APR 8500.1.

b. The Contractor shall comply with the "Burrowing Owl Management Policy

for Ames Research Center."

3.1.6 Cultural Resources, Plant Resources, and Habitat

Manage and control construction activities to minimize interference with and damage to cultural resources and plants and habitat. Do not disturb cultural resources. Do not alter water flows or otherwise significantly disturb the native habitat related to the project and critical to the preservation of cultural resources, and protected plants except as indicated or specified. Do not introduce non-native species.

3.1.7 Resource Conservation/Sustainability

The Contractor shall conduct its activities in a manner that conserves resources and minimizes pollution in accordance with NASA Ames EMS, NASA Strategic Sustainability Performance Plan, Executive Order 13423 "Strengthening Federal Environmental, Energy, and Transportation Management" and Executive Order 13514 "Federal Leadership in Environmental, Energy, and Economic Performance." All new construction, major renovation or repair and alteration of NASA buildings will comply with "Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings" (Guiding Principles) at http://www.wbdg.org/references/mou.php.

a. Minimize the amount of energy required during construction and operation by using resource efficient construction techniques, building systems (including HVAC, heating, electrical, water, lighting, heat-pumps and boilers), insulation, fixtures, appliances, and controls.

b. Whenever possible, utilize energy efficient office equipment through the Environmental Protection Agency's Energy Star labeling program (http://www.energystar.gov).

c. Use automated monitors and controls for energy, water, waste, temperature, moisture, and ventilation.

d. Conserve water with systems that reduce consumption and recycle water through reclamation and treatment systems.

e. Maximize the reduction, reuse, recycling or composting of waste and scrap materials.

f. Minimize waste, spillage, pilferage, spoil, and misuse of building materials.

g. Consider adaptive reuse, rather than demolition whenever possible.

h. Follow Federal Comprehensive Procurement Guidelines (http://www.epa.gov/epawaster/conserve/tools/cpg/index.htm) for building materials and products. Select materials that have a long-life cycle; select least toxic materials; select recyclable materials; select materials that are resource-efficient; select materials with the maximum recycled content; select materials harvested on a sustained yield basis; and select products causing the least pollution during their manufacture, use and reuse.

i. Reduce, reuse, and recycle to minimize consumption and waste in business operations.

j. Utilize environmental life cycle cost analysis in the development

process.

3.1.8 Hazardous Waste Management

3.1.8.1 Government Disposal

a. The Contractor shall label, package, and secondarily contain liquidhazardous wastes before submitting the hazardous wastes to the Government for subsequent disposal.

b. Hazardous Waste Manifest

1. NASA Ames Research Center shall be designated as the generator on the manifest and only approved Environmental Management Division personnel shall sign the Uniform Hazardous Waste Manifests. Contractors shall not sign hazardous waste manifests.

2. If the waste is generated from a tenant's site, where the tenant holds the generator permit, the tenant with requisite training must sign the manifest.

3. NASA Ames Research Center Ames Dispatch (650)604-5416 shall be designated as the emergency contact on the manifest.

3.1.8.2 Contractor Disposal

a. Hazardous wastes generated by materials brought on site by the Contractor shall be properly handled, shipped, and disposed of as required by Federal, State, and local regulations. No hazardous materials shall remain at the worksite upon completion of the project unless specified otherwise. The Government shall sample waste streams for purposes of waste characterization. Waste Profiles shall be submitted to the COR. Hazardous wastes shall be disposed of at a permitted Treatment, Storage, and Disposal Facility (TSDF) authorized to accept the specific waste to be shipped. Use of deep well injection as a treatment or disposal method is prohibited.

b. Hazardous Waste Manifest

1. NASA Ames Research Center shall be designated as the generator on the manifest and only approved Ames Environmental Management Division personnel shall sign the Uniform Hazardous Waste Manifests. Contractors shall not sign hazardous waste manifests.

2. If the waste is generated from a tenant's site, where the tenant holds the generator permit, the tenant with requisite training must sign the manifest.

3. NASA Ames Research Center (650)604-5416 (Ames Dispatch) shall be designated as the emergency contact on the manifest.

4. The Contractor shall prepare shipments in compliance with 49 CFR. The Contractor shall meet the removal and disposal time frames established by law.

5. The Contractor shall use only disposal facilities that have a valid permit to manage hazardous waste, and shall be responsible for determining that permit allows for the type of management and disposal intended for that waste. The Contractor shall be

responsible for ensuring that any party handling hazardous waste, including subcontractors, transporters, and TSDFs are in compliance with applicable Federal, State, and local regulations.

c. Treatment, Storage, And Disposal Facility List - The Contractor shall provide a list of storage and disposal facilities (TSDF) that perform treatment, storage, or disposal services under this contract. Each facility shall have, as a minimum, EPA RCRA interim status or state approval as a treatment or disposal facility and be in good standing with the regulatory community. Recycling facilities shall meet applicable Federal, State, and local regulations. The Contractor agrees that no facility other than those initially approved for use under this contract will be used, without first obtaining the written approval of the COR.

d. Hazardous Waste Liability - For the purpose of this contract, the Contractor shall be responsible for any release or threatened release of the materials or substances handled under this contract, as well as any liabilities resulting or arising from or related to this contract, and shall bear all costs pertaining to such releases including, but not limited to, responses, remediation, testing, or disposal costs, and further shall defend and indemnify the Government for any costs including, but not limited to, any judgments, penalties, assessments, litigation, or attorney fees.

e. Hazardous Waste Transportation - Certified Waste Haulers shall be utilized. Government directed waste shall be transported to the disposal facility or interim storage facility without delay, in accordance with Department of Transportation (DOT) manifest regulations. The Contractor shall notify the Government if 30 days or more have elapsed during shipment.

f. Containerized Hazardous Waste - Hazardous wastes and other materials picked up by the Contractor from other facilities may not be added to any container of Government hazardous waste.

g. Bulk Hazardous Waste - Bulk hazardous waste shipments shall be weighed to confirm shipping weight.

h. Fluorescent Light Tubes - Fluorescent light tubes removed by the Contractor shall be turned over to the Government for recycling.

3.1.9 Chemical Usage and Handling

a. Hazardous material shall be used only as described on the Material Safety Data Sheet. The Contractor shall wear the protective equipment recommended by the manufacturer. Containers of hazardous materials and hazardous wastes shall be kept closed except when in use. Containers of liquid hazardous materials shall be stored in secondary containment at the end of each work shift.

b. Reclamation of Equipment Containing Hazardous Material Residues - The Contractor shall disclose to COR the facility to which equipment containing hazardous material residues are shipped for reclamation, such as electrical wire wrapped with asbestos and electrical panels containing asbestos. The disclosure shall be documented on the Bill of Lading or by other written means.

c. Disposal of Non-Hazardous Waste Containing Hazardous Material Residue -

The Contractor shall disclose to COR the facility to which equipment containing hazardous material residues are shipped for disposal, such as steel coated with lead paint. The disclosure shall be documented on the Bill of Lading or by other written means. Supporting analytical data shall be included to document the equipment is not hazardous waste.

d. Labeling

1. Containers, drums, vessels, tanks, and associated piping containing hazardous materials shall be labeled in accordance with California Code of Regulations Title 8 Section 5194 and the most recent edition of the California Fire Code.

2. Label containers with description of contents, percentages of components (if not pure), hazardous properties, name of contact person or waste generator, phone number, and date. If material is a waste, container shall have a hazardous waste accumulation label.

3. Report such chemicals to NASA Ames Environmental Management Division if chemicals to be on-site for more than 20 working days. Division will enter chemicals into NASA Ames chemical inventory system and affix a label.

4. Report when chemicals labeled under d.3 are used up or removed from the Center so that the Division can remove from Ames chemical inventory.

3.2 FIELD QUALITY CONTROL

Comply with requirements of agencies having jurisdiction and as specified herein. Provide field practices, shipping, and handling of samples in accordance with ASTM D 4840. Provide Field Quality Control Reports in accordance with approved Environmental Protection Plan.

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SECTION 01 45 00.00 40

QUALITY CONTROL

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for inspections, test reports, and contractor obligations for establishing effective quality assurance procedures.

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Submit the following items in accordance with paragraph entitled, "Records," of this section.

Quality Control Data

Quality Control Coordinating Actions

Quality Control Training

Inspection Records

Letters of Authority or Delegation

Field Tests
Factory Tests

SD-07 Certificates

Submit a detailed written statement describing procedures that will be implemented to achieve quality on the project according to the paragraph entitled, "Quality Assurance (QA) Plan," of this section.

Submit the following in accordance with paragraph entitled, "Qualifications," of this section.

Contractor's Quality Representative Qualifications

Special Certifications

1.2.1 Quality Assurance (QA) Plan

Address the following within the QA Plan:

Description of the authority, responsibilities and coordinating procedures, of on-site/off-site quality assurance personnel, including those QA personnel not under direct control of the Contractor.

List personnel designated by the Contractor to accomplish the work required by the contract.

Provide an appendix with a copy of each form, report format, or similar record to be used in the QA program.

Contractor's organization that handles construction contract activities.

Contractor's operational plan for accomplishing and reviewing work controls, fabrication controls, certifications, and documentation of quality control operations, inspections, and test records, including those for subcontractors.

Include within these provisions the methods to be used during the procurement cycle (order to delivery) for those materials or equipment that require source inspections, shop fabrications, or similar operations located separately from the work site.

Description of on-site personnel training.

Certification(s) of personnel, procedures, processes, and equipment.

Nondestructive testing requirements.

Identification of independent certifying and testing laboratories.

1.2.2 Records

Include all quality control data; factory tests or manufacturer's certifications, quality control coordinating actions; records of quality control training/certifications as well as routine hydrostatic, electrical continuity, grounding, welding, line cleaning, field tests and similar tests. Quality records must be available for examination by the COR.

Furnish legible copies of the test and inspection records to the COR. Cover work placement traceable to the contract schedule, specifications and drawings, and must be verified by the Contractor.

Submit for approval, the narrative description of an inspection system which provides for compliance with the quality requirements and technical criteria of the contract within 5 working days after notice to proceed.

Submit Letters of Authority or Delegation outlining the authority and responsibilities of quality control personnel along with a copy of the letter of delegation to the COR that defines delegated duties and responsibilities.

In-process inspection records and control away from the job site may be used as evidence of quality of materials/work and may reduce further inspection or testing after delivery to the job site.

Records of waste and recycling shall be maintained as described in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

When approval or certification of special processes, operating personnel, and special equipment or procedures is required by the specifications, obtain necessary approvals or special certifications prior to starting the work.

1.3.2 Quality Control Requirements

Provide a quality control program encompassing: selection of construction materials and sources; suppliers; subcontractors; on-site and off-site fabrication of Contractor-furnished assemblies; on-site and off-site assembly; erection; work procedures; workmanship; inspection; and testing.

Provide document systems ensuring that quality provisions of contract schedule, specifications, and drawings have been performed.

1.3.2.1 Management and Organization

Designate an individual within the on-site organization whose responsibility is the day-to-day on-site management and direction of the Quality Program including quality control of any work performed by subcontractors.

The Quality Program Manager will report to the Contractor's management and have the necessary authority to discharge contractual responsibilities.

1.3.2.2 Identification and Data Retrieval

Provide an identification and data retrieval system.

Records, drawings, submittals, and equipment must be identified by referencing the Contract Number; Contract Specification Number; Contract Drawing Number; Submittal Document Number; Contract Change Number; and the Contractor's Drawing Number System.

1.3.2.3 Procurement

Contractor is responsible for controlling procurement sources and those of his subcontractors to ensure that each purchase meets quality requirements.

1.3.2.4 Receiving Inspection System

Maintain a site receiving inspection system that ensures procured materials and equipment are inspected and tested.

Receiving inspection records must accompany each procurement delivery to the construction site. Maintain records of site receiving inspections.

Show defects, discrepancies, dispositions, and waivers, including evidence of Government source inspection within the records. When waivers are required the COR shall provide form ARC 762.

1.3.2.5 Nonconforming Articles and Material Control

Control nonconformances discovered by the Contractor, subcontractors, suppliers or Government quality representatives to prevent their use and to

correct deficient operations.

a. Prepare a "nonconformance" report for each instance comprising:

1. A unique and traceable number.

2. Identification of the nonconforming article or material.

3. A description of the nonconformance and the applicable requirement.

4. Cause or reason for the nonconformance.

5. Remedial actions taken or recommended.

6. Disposition of the nonconforming article or material.

b. Identify and mark each nonconforming article for removal from the work area.

c. Monitor and correct deficient operations.

1.3.2.6 Fabrication, Process, and Work Control

Ensure compliance of requirements in contract specifications and drawings with procedures and controls.

Establish in-process inspections, to ensure compliance with quality requirements.

1.3.2.7 Quality Control Records

Maintain Quality Control records at a central on-site location.

Maintenance of quality control records do not relieve the Contractor from submitting samples, test data, detail drawings, material certificates, or other information required by each section in the specification.

Ensure each record is identified and traceable to specific requirements in the specifications and drawings.

1.3.2.8 Drawings and Change Control

Maintain drawing-control system to provide revised drawings and ensure continuous removal of obsolete drawings from work areas. Control changes involving interface with other work areas, or affecting materials controlled by others. Integrate this system with the document requirements of the contract.

Clearly annotate and identify drawing changes and associated drawings for implementation that are to be revised accordingly. Use for fabrication and inspection drawings that have been approved, or approved as noted, by the COR.

1.3.3 Quality Inspections

1.3.3.1 Government Inspections

Work performed under this contract will be subject to verification and/or inspection by the COR. Changes to the specifications or drawings will not

be allowed without written authorization of the COR.

When the COR determines that inspected work needs to be corrected, the COR will be allowed 24 hours to complete reinspection of the corrected work.

Notify COR in writing before backfilling or encasing any underground utility so that work may be inspected. Failure to notify the COR before backfill or encasement occurs will require the work be uncovered at no additional cost to the Government.

Contractor's program is subject to continuous evaluation, review, and verification by the COR. Contractor will be notified in writing of any noncompliance and will be given 3 working days to correct identified deficiencies.

1.3.3.2 Contractor's Quality Inspections

Implement an inspection system that Documents and indicates quality control through records of inspections, tests, and procedures.

Include the following within the Contractor's Quality Assurance System:

a. Single Contractor's representative responsible for on-site communication and operation of the inspection program.

b. Purchasing control system documenting project procurement to drawings, specifications, and approved submittals.

c. Receiving inspection system documenting inspections for each procurement.

d. Documentation for handling and disposing of nonconforming components and materials.

e. Inspection records for each specific section of the specification and drawings.

f. Identification of test(s) to be performed, test procedures, records, and independent organizations used.

g. Documenting and maintaining certification or re-certification of procedures.

h. Management of government-furnished equipment, components, and materials.

i. Calibration of gages, tools, measuring instruments, and independent laboratories used.

Establish a system of scheduled or random audits to ensure task completion.

1.3.4 Field Services

1.3.4.1 Responsibility for Inspection and Testing

Contractor is responsible for all inspections and tests, and the accompanying documentation for each inspection and test. The Contractor shall utilize independent inspection and testing laboratories or services as approved by the COR.

Contractor is also be responsible for tests of construction materials utilizing the services of an approved independent testing laboratory.

1.3.4.2 Inspection and Test Records

Provide on-site records of each inspection and test performed throughout the life of the contract including, but not be limited to, factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved, identification of operators and inspectors, result of inspections or tests, nature of defects, causes for rejection, proposed remedial action, and corrective actions taken.

Inspection records, test procedures, test results, and associated forms be verified by and provided to the COR. Final test data must have a cover letter/sheet clearly marked with the system name, date, and the words "Final Test Data".

1.4 HANDLING AND STORAGE

Provide controls, procedures and documentation with each shipment, that meet requirements of each section of the specifications.

Include documentation with each shipment that consist of documentation required by the contract along with specifications required to identify, store, preserve, operate, and maintain the items shipped.

1.5 SEQUENCING AND SCHEDULING

Notify the Government at least 3 working days prior to scheduled inspections and tests.

Provide 10 working days notice to the Government of the date when the contract work will begin at the site.

When Contractor suspends work for 3 working days or longer prior to completion notify the COR. Do not resume work without notification of the COR.

Notify the COR at least 1 working day in advance of backfilling or encasing any underground utility.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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SECTION 01 50 00

TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for temporary construction facilities, safety systems, construction traffic provisions, construction signage and controls over contractor operations required for use in all projects.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241	Standard for Safeguarding Construction,Alteration, and Demolition Operations

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	Obstruction Marking and Lighting

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction site plan
Traffic control plan

1.4 CONSTRUCTION SITE PLAN

Prior to the start of work, submit a site plan showing the locations and dimensions of temporary facilities (including layouts and details, equipment and material storage area (onsite and offsite), and access and haul routes, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas which may have to be graveled to prevent the tracking of mud. Indicate if the use of a supplemental or other staging area is desited. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary

sanitary facilities, and worker parking areas.

1.5 BACKFLOW PREVENTERS CERTIFICATE

Certificate of Full Approval from FCCCHR List, University of Southern California, attesting that the design, size and make of each backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. Certificate of Provisional Approval will not be acceptable.

1.5.1 Backflow Tester Certificate

Prior to testing, submit to the COR certification issued by the State or local regulatory agency attesting that the backflow tester has successfully completed a certification course sponsored by the regulatory agency. Tester must not be affiliated with any company participating in any other phase of this Contract.

1.5.2 Backflow Prevention Training Certificate

Submit a certificate recognized by the State or local authority that states the Contractor has completed at least 10 hours of training in backflow preventer installations. The certificate must be current.

PART 2 PRODUCTS

2.1 TEMPORARY SIGNAGE

2.1.1 Bulletin Board

Immediately upon beginning of work, provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the COR. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, as approved by the COR.

2.1.2 Advertising Signage

Advertisement signage shall not be erected.

2.2 TEMPORARY TRAFFIC CONTROL

2.2.1 Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic barricades will be required. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

2.2.2 Fencing

a. Provide fencing along the construction site at all open excavations and tunnels to control access by unauthorized people. Fencing must be installed to be able to restrain a force of at least 250 pounds against

it.

b. Enclose the outdoor project work area and Contractor lay-down area with an 8 ft high chain link fence and gates. Remove the fence upon completion and acceptance of the work.

2.2.3 Temporary Wiring

Provide temporary wiring in accordance with NFPA 241 and CEC and NFPA 70, Article 305-6(b), Assured Equipment Grounding Conductor Program. Include frequent inspection of all equipment and apparatus.

PART 3 EXECUTION

3.1 EMPLOYEE PARKING

Contractor employees will park privately owned vehicles in an area designated by the COR. This area will be within reasonable walking distance of the construction site. Contractor employee parking must not interfere with existing and established parking requirements of the government installation.

3.2 AVAILABILITY AND USE OF UTILITY SERVICES

3.2.1 Temporary Utilities

Provide temporary utilities required for construction. Materials may be new or used, must be adequate for the required usage, not create unsafe conditions, and not violate applicable codes and standards.

3.2.2 Electricity

Provide connections, sized to provide service required for power and lighting. Locate feeder and branch wiring with area distribution boxes so that power is available throughout the project site by use of power cords. Provide lighting as required for safe and secure operations. Electricity used will be furnished by the Government. Maximum power supplied by the Government will be 120V/1PH.

3.2.3 Water

Make connections to existing facilities to provide water for construction purposes. Water used will be furnished by the Government. Any water provided by the Government will be protected by an air gap.

3.2.4 Sanitation

a. Provide and maintain within the construction area minimum field-type sanitary facilities approved by the COR and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Obtain approval from the system owner prior to discharge into any municipal, district, or commercial sanitary sewer system. Any penalties and/or fines associated with improper discharge will be the responsibility of the Contractor. Coordinate with the COR and follow station regulations and procedures when discharging into the station sanitary sewer system. Maintain these conveniences at all times without nuisance. Include provisions for pest control and elimination of odors. Government toilet facilities will not be available to Contractor's personnel.

b. Provide temporary sewer and sanitation facilities that are self-contained units with both urinals and stool capabilities. Ventilate the units to control odors and fumes and empty and clean them at least once a week or more often if required by the COR. The doors shall be self-closing. The exterior of the unit shall match the base standard color. Locate the facility behind the construction fence or out of the public view.

3.2.5 Telephone

Make arrangements and pay all costs for telephone facilities desited.

3.2.6 Obstruction Lighting of Cranes

Provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet above ground level. Light construction and installation must comply with FAA AC 70/7460-1. Lights must be operational during periods of reduced visibility, darkness, and as directed by the COR.

3.2.7 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.

3.3 TRAFFIC PROVISIONS

3.3.1 Maintenance of Traffic

a. Conduct operations in a manner that will not close any thoroughfare or interfere in any way with traffic on railways or highways except with written permission of the COR at least 10 working days prior to the proposed modification date, and provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval. The plan must be in accordance with State and local regulations. Make all notifications and obtain any permits required for modification to traffic movements outside NASA's jurisdiction. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.

b. Conduct work so as to minimize obstruction of traffic, and maintain traffic on at least half of the roadway width at all times. Obtain approval from the COR prior to starting any activity that will obstruct traffic.

c. Provide, erect, and maintain, at contractors expense, lights, barriers, signals, passageways, detours, and other items, that may be required by the Life Safety Signage, overhead protection authority having jurisdiction.

3.3.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the COR. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of

adequate warning, danger, and direction signs, will be as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of any damage to roads caused by construction operations.

3.3.3 Rush Hour Restrictions

Do not interfere with the peak traffic flows preceding and during normal operations for Bush Circle and the Main Gate without notification to and approval by the COR.

3.3.4 Dust Control

Dust control methods and procedures must be approved by the COR. Treat dust abatement on access roads with applications of calcium chloride, water sprinklers, or similar methods or treatment.

3.4 CONTRACTOR'S TEMPORARY FACILITIES

3.4.1 Safety

Protect the integrity of any installed safety systems or personnel safety devices. If entrance into systems serving safety devices is required, the Contractor must obtain prior approval from the COR. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and obtain approval from the COR.

3.4.2 Administrative Field Offices

The Contractor may, at its option and the COR's discretion, furnish and maintain a trailer-type mobile office acceptable to the and providing as a minimum the facilities specified above. The trailer must be at least 20 feet from existing buildings.

3.4.3 Trailers or Storage Buildings

Trailers or storage buildings will be permitted, where space is available, subject to the approval of the COR. The trailers or buildings shall be in good condition, free from visible damage rust and deterioration, and meet all applicable safety requirements. Trailers shall be roadworthy and comply with all appropriate state and local vehicle requirements. Failure to maintain storage trailers or buildings to these standards shall result in the removal of non-complying units at the Contractor's expense. A sign not smaller than 24 by 24 inches shall be conspicuously placed on the trailer depicting the company name, business phone number, and emergency phone number. Trailers shall be anchored to resist high winds and must meet applicable state of local standards for anchoring mobile trailers.

3.4.4 Storage Area

Construct a temporary 6 foot high chain link fence around materials. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Do not place or store Trailers, materials, or equipment outside the fenced area unless such trailers, materials, or equipment are assigned

a separate and distinct storage area by the COR away from the vicinity of the construction site but within the installation boundaries. Trailers, equipment, or materials must not be open to public view with the exception of those items which are in support of ongoing work on any given day. Do not stockpile materials outside the fence in preparation for the next day's work. Park mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment within the fenced area at the end of each work day.

3.4.5 Supplemental Storage Area

Upon Contractor's request, the COR will designate another or supplemental area for the Contractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but will be within the installation boundaries. Fencing of materials or equipment will not be required at this site; however, the Contractor is responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.

3.4.6 Appearance of Trailers

a. Trailers utilized by the Contractor for administrative or material storage purposes must present a clean and neat exterior appearance and be in a state of good repair. Trailers which, in the opinion of the COR, require exterior painting or maintenance will not be allowed on installation property.

3.4.7 Maintenance of Storage Area

a. Keep fencing in a state of good repair and proper alignment. Grassed or unpaved areas, which are not established roadways, will be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles; gravel gradation will be at the Contractor's discretion. Mow and maintain grass located within the boundaries of the construction site for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers will be edged or trimmed neatly.

b. Cut grass (or annual weeds) within the construction and storage sites to a maximum 4 inch height at least once a week during the growing season unless the grass area is not visible to the public. Trim the grass around fences at time of grass cutting. Maintain grass or weeds on stockpiled earth as descried above.

3.4.8 Security Provisions

Provide adequate outside security lighting at the Contractor's temporary facilities. The Contractor will be responsible for the security of its own equipment; in addition, the Contractor will notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

3.4.9 Weather Protection of Temporary Facilities and Stored Materials

Take necessary precautions to ensure that roof openings and other critical

openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment in the building from damage.

3.5 TEMPORARY PROJECT SAFETY FENCING

At the COR's discretion, but not later than 10 working days after the date established for commencement of work, furnish and erect temporary project safety fencing at the work site. The safety fencing must be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 42 inches high, supported and tightly secured to steel posts located on maximum 10 foot centers, constructed at the approved location. Maintain the safety fencing during the life of the contract and, upon completion and acceptance of the work, will become the property of the Contractor and be removed from the work site.

3.6 CLEANUP

Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store within the fenced area described above or at the supplemental storage area any materials resulting from demolition activities which are salvageable. Neatly stacked stored materials not in trailers, whether new or salvaged.

3.7 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletin board, signs, barricades, haulroads, and any other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence that will become the property of the Contractor. Restore to the original or better condition, areas used by the Contractor for the storage of equipment or material, or other use. Gravel used to traverse grassed areas must be removed and the area restored to its original condition, including top soil and seeding as necessary.

-- End of Section --

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TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for environmental protection and other environmental temporary controls.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 833-R-060-04	Developing Your Storm Water Pollution Prevention Plan, a Guide for Construction Sites

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
40 CFR 112	Oil Pollution Prevention
40 CFR 122.26	Storm Water Discharges (Applicable to State NPDES Programs, see section 123.25)
40 CFR 241	Guidelines for Disposal of Solid Waste
40 CFR 243	Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste
40 CFR 258	Subtitle D Landfill Requirements
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste

40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program
40 CFR 271	Requirements for Authorization of State Hazardous Waste Programs
40 CFR 272	Approved State Hazardous Waste Management Programs
40 CFR 273	Standards For Universal Waste Management
40 CFR 279	Standards for the Management of Used Oil
40 CFR 280	Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST)
40 CFR 372-SUBPART D	Specific Toxic Chemical Listings
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
40 CFR 82	Protection of Stratospheric Ozone
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 178	Specifications for Packagings

1.3 DEFINITIONS

1.3.1 Sediment

Soil and other debris that have eroded and have been transported by runoff water or wind.

1.3.2 Solid Waste

Garbage, refuse, debris, sludge, or other discharged material, including solid, liquid, semisolid, or contained gaseous materials resulting from domestic, industrial, commercial, mining, or agricultural operations. Types of solid waste typically generated at construction sites may include:

a. Green waste: The vegetative matter from landscaping, land clearing and grubbing, including, but not limited to, grass, bushes, scrubs, small trees and saplings, tree stumps and plant roots. Marketable trees, grasses and plants that are indicated to remain, be re-located, or be re-used are not included.

b. Surplus soil: Existing soil that is in excess of what is required for this work, including aggregates intended, but not used, for on-site mixing of concrete, mortars and paving. Contaminated soil meeting the definition of hazardous material or hazardous waste is not included.

c. Debris: Non-hazardous solid material generated during the construction, demolition, or renovation of a structure which exceeds 2.5 inch particle size that is: a manufactured object; plant or animal matter; or natural geologic material (e.g. cobbles and boulders), broken or removed concrete, masonry, and rock asphalt paving; ceramics; roofing paper and shingles. Inert materials may be reinforced with or contain ferrous wire, rods, accessories and weldments. A mixture of debris and other material such as soil or sludge is also subject to regulation as debris if the mixture is comprised primarily of debris by volume, based on visual inspection.

d. Wood: Dimension and non-dimension lumber, plywood, chipboard, hardboard. Treated and/or painted wood that meets the definition of lead contaminated or lead based contaminated paint is not included.

e. Scrap metal: Scrap and excess ferrous and non-ferrous metals such as reinforcing steel, structural shapes, pipe and wire that are recovered or collected and disposed of as scrap. Scrap metal meeting the definition of hazardous material or hazardous waste is not included.

f. Paint cans: Metal cans that are empty of paints, solvents, thinners and adhesives. If permitted by the paint can label, a thin dry film may remain in the can.

g. Recyclables: Materials, equipment and assemblies such as doors, windows, door and window frames, plumbing fixtures, glazing and mirrors that are recovered and sold as recyclable. Metal meeting the definition of lead contaminated or lead based paint contaminated may not be included as recyclable if sold to a scrap metal company. Paint cans may not be included as recyclable if sold to a scrap metal company.

h. Hazardous Waste: By definition, to be a hazardous waste a material must first meet the definition of a solid waste. Hazardous waste and hazardous debris are special cases of solid waste. They have

additional regulatory controls and must be handled separately. They are thus defined separately in this document.

Material not regulated as solid waste are: nuclear source or byproduct materials regulated under the Federal Atomic Energy Act of 1954 as amended; suspended or dissolved materials in domestic sewage effluent or irrigation return flows, or other regulated point source discharges; regulated air emissions; and fluids or wastes associated with natural gas or crude oil exploration or production.

1.3.3 Hazardous Debris

As defined in Solid Waste paragraph, debris that contains listed hazardous waste (either on the debris surface, or in its interstices, such as pore structure) per 40 CFR 261; or debris that exhibits a characteristic of hazardous waste per 40 CFR 261.

1.3.4 Chemical Wastes

This includes salts, acids, alkalizes, herbicides, pesticides, and organic chemicals.

1.3.5 Garbage

Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.3.6 Hazardous Waste

Any discarded material, liquid, solid, or gas, which meets the definition of hazardous material or is designated hazardous waste by the Environmental Protection Agency or State Hazardous Control Authority as defined in 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, 40 CFR 268, 40 CFR 270, 40 CFR 271, 40 CFR 272, 40 CFR 273, 40 CFR 279, and 40 CFR 280.

1.3.7 Hazardous Materials

Hazardous materials as defined in 49 CFR 171 and listed in 49 CFR 172 and State and Local regulations.

Hazardous material is any material that:

a. Is regulated as a hazardous material per 49 CFR 173, or

b. Requires a Material Safety Data Sheet (MSDS) per 29 CFR 1910.120, or

c. During end use, treatment, handling, packaging, storage, transpiration, or disposal meets or has components that meet or have potential to meet the definition of a hazardous waste as defined by 40 CFR 261 Subparts A, B, C, or D.

Designation of a material by this definition, when separately regulated or controlled by other instructions or directives, does not eliminate the need for adherence to that hazard-specific guidance which takes precedence over this instruction for "control" purposes. Such material include ammunition, weapons, explosive actuated devices, propellants, pyrotechnics, chemical and biological warfare materials, medical and pharmaceutical supplies, medical waste and infectious materials, bulk fuels, radioactive materials,

and other materials such as asbestos, mercury, and polychlorinated biphenyls (PCBs). Nonetheless, the exposure may occur incident to manufacture, storage, use and demilitarization of these items.

1.3.8 Waste Hazardous Material (WHM)

Any waste material which because of its quantity, concentration, or physical, chemical, or infectious characteristics may pose a substantial hazard to human health or the environment and which has been so designated. Used oil not containing any hazardous waste, as defined above, falls under this definition.

1.3.9 Oily Waste

Those materials which are, or were, mixed with used oil and have become separated from that used oil. Oily wastes also means materials, including wastewaters, centrifuge solids, filter residues or sludges, bottom sediments, tank bottoms, and sorbents which have come into contact with and have been contaminated by, used oil and may be appropriately tested and discarded in a manner which is in compliance with other State and local requirements.

Large quantities of this material, generated as a result of a major spill or in lieu of proper maintenance of the processing equipment, are a solid waste. As a solid waste, a hazardous waste determination must be performed prior to disposal. As this can be an expensive process, it is recommended that this type of waste be minimized through good housekeeping practices and employee education.

1.3.10 Regulated Waste

Those solid waste that have specific additional Federal, state, or local controls for handling, storage, or disposal.

1.3.11 Class I Ozone Depleting Substance (ODS)

Class I ODS is defined in Section 602(a) of The Clean Air Act and includes the following chemicals:

chlorofluorocarbon-11 (CFC-11)
chlorofluorocarbon-12 (CFC-12)
chlorofluorocarbon-13 (CFC-13)
chlorofluorocarbon-111 (CFC-111)
chlorofluorocarbon-112 (CFC-112)
chlorofluorocarbon-113 (CFC-113)
chlorofluorocarbon-114 (CFC-114)
chlorofluorocarbon-115 (CFC-115)
chlorofluorocarbon-211 (CFC-211)
chlorofluorocarbon-212 (CFC-212)
chlorofluorocarbon-213 (CFC-213)
chlorofluorocarbon-214 (CFC-214)
chlorofluorocarbon-215 (CFC-215)
chlorofluorocarbon-216 (CFC-216)
chlorofluorocarbon-217 (CFC-217)
chlorofluorocarbon-500 (CFC-500)
chlorofluorocarbon-502 (CFC-502)
chlorofluorocarbon-503 (CFC-503)
halon-1211
halon-1301

halon-2402
carbon tetrachloride
methyl bromide
methyl chloroform

Class II ODS is defined in Section 602(s) of The Clean Air Act and includes the following chemicals:

hydrochlorofluorocarbon-21 (HCFC-21)
hydrochlorofluorocarbon-22 (HCFC-22)
hydrochlorofluorocarbon-31 (HCFC-31)
hydrochlorofluorocarbon-121 (HCFC-121)
hydrochlorofluorocarbon-122 (HCFC-122)
hydrochlorofluorocarbon-123 (HCFC-123)
hydrochlorofluorocarbon-124 (HCFC-124)
hydrochlorofluorocarbon-131 (HCFC-131)
hydrochlorofluorocarbon-132 (HCFC-132)
hydrochlorofluorocarbon-133 (HCFC-133)
hydrochlorofluorocarbon-141 (HCFC-141)
hydrochlorofluorocarbon-142 (HCFC-142)
hydrochlorofluorocarbon-221 (HCFC-221)
hydrochlorofluorocarbon-222 (HCFC-222)
hydrochlorofluorocarbon-223 (HCFC-223)
hydrochlorofluorocarbon-224 (HCFC-224)
hydrochlorofluorocarbon-225 (HCFC-225)
hydrochlorofluorocarbon-226 (HCFC-226)
hydrochlorofluorocarbon-231 (HCFC-231)
hydrochlorofluorocarbon-232 (HCFC-232)
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hydrochlorofluorocarbon-241 (HCFC-241)
hydrochlorofluorocarbon-242 (HCFC-242)
hydrochlorofluorocarbon-243 (HCFC-243)
hydrochlorofluorocarbon-244 (HCFC-244)
hydrochlorofluorocarbon-251 (HCFC-251)
hydrochlorofluorocarbon-252 (HCFC-252)
hydrochlorofluorocarbon-253 (HCFC-253)
hydrochlorofluorocarbon-261 (HCFC-261)
hydrochlorofluorocarbon-262 (HCFC-262)
hydrochlorofluorocarbon-271 (HCFC-271)

1.3.11.1 Universal Waste

The universal waste regulations streamline collection requirements for certain hazardous wastes in the following categories: batteries, pesticides, mercury-containing equipment (e.g., thermostats) and lamps (e.g., fluorescent bulbs). The rule is designed to reduce hazardous waste in the municipal solid waste (MSW) stream by making it easier for universal waste handlers to collect these items and send them for recycling or proper disposal. These regulations can be found at 40 CFR 273.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Preconstruction Survey

Solid Waste Management Plan and Permit

Regulatory Notifications

Environmental Management Plan

Storm Water Pollution Prevention Plan

Storm Water Notice of Intent (for NPDES coverage under the general permit for construction activities)

Dirt and Dust Control Plan

Contractor Hazardous Material Inventory Log

SD-06 Test Reports

Laboratory Analysis

Disposal Requirements

Erosion and Sediment Control Inspection Reports

Storm Water Inspection Reports for General Permit

Contractor 40 CFR employee training records

Solid Waste Management Report; G

SD-11 Closeout Submittals

Some of the records listed below are also required as part of other submittals. For the "Records" submittal, maintain on-site a separate three-ring Environmental Records binder and submit at the completion of the project. Make separate parts to the binder corresponding to each of the applicable sub items listed below.

Storm Water Pollution Prevention Plan compliance notebook

Waste Determination Documentation

Disposal Documentation for Hazardous and Regulated Waste

Contractor 40 CFR Employee Training Records

Solid Waste Management Permit

Solid Waste Management Report

Contractor Hazardous Material Inventory Log

Hazardous Waste/Debris Management

Regulatory Notifications

1.5 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with Federal, State, and local regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

The Contractor may be required to promptly conduct tests and procedures for the purpose of assessing whether construction operations are in compliance with Applicable Environmental Laws. Analytical work shall be done by qualified laboratories; and where required by law, the laboratories shall be certified.

1.5.1 Conformance with the Environmental Management System

The Contractor shall perform work under this contract consistent with the policy and objectives identified in the installation's Environmental Management System (EMS). The Contractor shall perform work in a manner that conforms to objectives and targets, environmental programs and operational controls identified by the EMS. The Contractor will provide monitoring and measurement information as necessary to address environmental performance relative to environmental, energy, and transportation management goals. In the event an EMS nonconformance or environmental noncompliance associated with the contracted services, tasks, or actions occurs, the Contractor shall take corrective and/or preventative actions. In addition, the Contractor shall ensure that its employees are aware of their roles and responsibilities under the EMS and how these EMS roles and responsibilities affect work performed under the contract.

The Contractor is responsible for ensuring that their employees receive applicable environmental and occupational health and safety training, and keep up to date on regulatory required specific training for the type of work to be conducted onsite. All on-site Contractor personnel, and their subcontractor personnel, performing tasks that have the potential to cause a significant environmental impact shall be competent on the basis of appropriate education, training or experience. Upon contract award, the COR's Representative will notify the installation's EMS coordinator to arrange EMS training. The installation's EMS coordinator shall identify training needs associated with environmental aspects and the EMS, and arrange training or take other action to meet these needs. The Contractor shall provide training documentation to the COR. The EMS coordinator shall retain associated records.

1.6 QUALITY ASSURANCE

1.6.1 Preconstruction Survey

Perform a Preconstruction Survey of the project site with the COR, and take photographs showing existing environmental conditions in and adjacent to the site. Submit a report for the record.

1.6.2 Regulatory Notifications

The Contractor is responsible for all regulatory notification requirements

in accordance with Federal, State and local regulations. In cases where must also provide public notification (such as stormwater permitting), the Contractor must coordinate with the COR. The Contractor shall submit copies of all regulatory notifications to the COR prior to commencement of work activities. Typically, regulatory notifications must be provided for the following (this listing is not all inclusive): demolition, renovation, NPDES defined site work, remediation of controlled substances (asbestos, hazardous waste, lead paint).

1.6.3 Environmental Brief

Attend an environmental brief to be included in the preconstruction meeting. Provide the following information: types, quantities, and use of hazardous materials that will be brought onto the activity; types and quantities of wastes/wastewater that may be generated during the contract. Discuss the results of the Preconstruction Survey at this time.

Prior to initiating any work on site, meet with the COR and activity environmental staff to discuss the proposed Environmental Management Plan. Develop a mutual understanding relative to the details of environmental protection, including measures for protecting natural resources, required reports, required permits, permit requirements, and other measures to be taken.

1.6.4 Environmental Manager

Appoint in writing an Environmental Manager for the project site. The Environmental Manager will be directly responsible for coordinating contractor compliance with Federal, State, local, and station requirements. The Environmental Manager will ensure compliance with Hazardous Waste Program requirements (including hazardous waste handling, storage, manifesting, and disposal); implement the Environmental Management Plan; ensure that all environmental permits are obtained, maintained, and closed out; ensure compliance with Storm Water Program Management requirements; ensure compliance with Hazardous Materials (storage, handling, and reporting) requirements; and coordinate any remediation of regulated substances (lead, asbestos, PCB transformers). This can be a collateral position; however the person in this position must be trained to adequately accomplish the following duties: ensure waste segregation and storage compatibility requirements are met; inspect and manage Satellite Accumulation areas; ensure only authorized personnel add wastes to containers; ensure all Contractor personnel are trained in 40 CFR requirements in accordance with their position requirements; coordinate removal of waste containers; and maintain the Environmental Records binder and required documentation, including environmental permits compliance and close-out.

1.6.5 Contractor 40 CFR Employee Training Records

Prepare and maintain employee training records throughout the term of the contract meeting applicable 40 CFR requirements. The Contractor will ensure every employee completes a program of classroom instruction or on-the-job training that teaches them to perform their duties in a way that ensures compliance with Federal, State and local regulatory requirements for RCRA Large Quantity Generator. The Contractor will provide a Position Description for each employee, by subcontractor, based on the Davis-Bacon Wage Rate designation or other equivalent method, evaluating the employee's association with hazardous and regulated wastes. This Position Description will include training requirements as defined in 40 CFR 265 for a Large

Quantity Generator facility. Submit these training records to the COR at the conclusion of the project, unless otherwise directed.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 ENVIRONMENTAL MANAGEMENT PLAN

Prior to initiating any work on site, the Contractor will meet with the COR to discuss the proposed Environmental Protection Plan and develop a mutual understanding relative to the details of environmental protection, including measures for protecting natural resources, required reports, and other measures to be taken. The Contractor's Environmental Plan shall incorporate construction related objectives and targets from the installation's Environmental Management System. The Environmental Management Plan will be submitted in the following format and shall include the elements specified below.

a. Description of the Environmental Management Plan

1. General overview and purpose

(a) A brief description of each specific plan required by environmental permit or elsewhere in this contract.

(b) The duties and level of authority assigned to the person(s) on the job site that oversee environmental compliance.

(c) A copy of any standard or project specific operating procedures that will be used to effectively manage and protect the environment on the project site.

(d) Communication and training procedures that will be used to convey environmental management requirements to contractor employees and subcontractors.

(e) Emergency contact information contact information (office phone number, cell phone number, and e-mail address).

2. General site information

b. Management of Natural Resources

1. Land resources

2. Tree protection

3. Replacement of damaged landscape features

4. Temporary construction

5. Stream crossings

6. Fish and wildlife resources

7. Wetland areas

c. Protection of Historical and Archaeological Resources

1. Objectives

2. Methods

d. Storm Water Management and Control

1. Ground cover

2. Erodible soils

3. Temporary measures

(a) Mechanical retardation and control of runoff

(b) Vegetation and mulch

(4) Effective selection, implementation and maintenance of Best Management Practices (BMPs).

e. Protection of the Environment from Waste Derived from Contractor Operations

1. Control and disposal of solid and sanitary waste. If Section 01 74 19.05 20 is included in the contract, submit the plan required by that section as part of the Environmental Management Plan.

2. Control and disposal of hazardous waste (Hazardous Waste Management Section)

This item will consist of the management procedures for all hazardous waste to be generated. The elements of those procedures will coincide with the Activity Hazardous Waste Management Plan. As a minimum, include the following:

(a) Procedures to be employed to ensure a written waste determination is made for appropriate wastes which are to be generated;

(b) Sampling/analysis plan;

(c) Methods of hazardous waste accumulation/storage (i.e., in tanks and/or containers);

(d) Management procedures for storage, labeling, transportation, and disposal of waste (treatment of waste is not allowed unless specifically noted);

(e) Management procedures and regulatory documentation ensuring disposal of hazardous waste complies with Land Disposal Restrictions (40 CFR 268);

(f) Management procedures for recyclable hazardous materials such as lead-acid batteries, used oil, and the like;

(g) Used oil management procedures in accordance with 40 CFR 279;

(h) Pollution prevention\hazardous waste minimization procedures;

(i) Plans for the disposal of hazardous waste by permitted facilities;

(j) Procedures to be employed to ensure all required employee training records are maintained.

f. Prevention of Releases to the Environment

(1) Procedures to prevent releases to the environment

(2) Notifications in the event of a release to the environment

g. Regulatory Notification and Permits

List what notifications and permit applications must be made. Demonstrate that those permits have been obtained by including copies of all applicable, environmental permits.

3.1.1 Environmental Protection Plan Review

Within thirty days after the Contract award date, submit the proposed Environmental Management Plan for further discussion, review, and approval. Commencement of work will not begin until the environmental management plan has been approved.

3.1.2 Licenses and Permits

The following permits will be obtained by the COR:

a. Air permits

b. Santa Clara County Permits (closures, installation, storage of hazardous materials, temporary fuel tanks for generators, air compressors, etc.)

c. Storm water permits (Notice of Intent, Notice of Termination).

d. Water discharge permits (discharges to the local publicly owned treatment works, POTW)

e. Migratory bird permit (if required)

The Contractor must provide all necessary documentation for acquiring the necessary permits. For permits obtained by the COR, whether or not required by the permit, the Contractor is responsible for conforming to all permit requirements and performing all quality control inspections of the work in progress, and to submit notifications and certifications to the applicable regulatory agency via the COR. The Contractor is responsible for obtaining their own permits for their equipment used during construction.

3.2 PROTECTION OF NATURAL RESOURCES

Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work. Confine construction activities to within the limits of the work indicated or specified. If the work is near

streams, lakes, or other waterways, conform to the national permitting requirements of the Clean Water Act.

Do not disturb fish and wildlife. Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as indicated or specified.

Except in areas to be cleared, do not remove, cut, deface, injure, or destroy trees or shrubs without the COR's permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless authorized by the COR. Where such use of attached ropes, cables, or guys is authorized, the Contractor will be responsible for any resultant damage.

Protect existing trees which are to remain and which may be injured, bruised, defaced, or otherwise damaged by construction operations. Remove displaced rocks from uncleared areas. By approved excavation, remove trees with 30 percent or more of their root systems destroyed. Remove trees and other landscape features scarred or damaged by equipment operations, and replace with equivalent, undamaged trees and landscape features. Obtain COR's approval before replacement.

The COR's approval is required before any equipment will be permitted to ford live streams. In areas where frequent crossings are required, install temporary culverts or bridges. Obtain COR's approval prior to installation. Remove temporary culverts or bridges upon completion of work, and repair the area to its original condition unless otherwise required by the COR.

3.2.1 Erosion and Sediment Control Measures

3.2.1.1 Burnoff

Burnoff of the ground cover is not permitted.

3.2.1.2 Protection of Erodible Soils

Immediately finish the earthwork brought to a final grade, as indicated or specified. Immediately protect the side slopes and back slopes upon completion of rough grading. Plan and conduct earthwork to minimize the duration of exposure of unprotected soils.

3.2.1.3 Temporary Protection of Erodible Soils

Use the following methods to prevent erosion and control sedimentation:

a. Mechanical Retardation and Control of Runoff

Mechanically retard and control the rate of runoff from the construction site. This includes construction of diversion ditches, benches, berms, and use of silt fences and straw bales to retard and divert runoff to protected drainage courses.

3.2.2 Erosion and Sediment Control Inspection Reports

Note erosion control inspection reports may be compiled as part of a stormwater pollution prevention plan inspection reports if applicable.

3.2.2.1 Storm Water Notice of Intent for Construction Activities and Storm Water Pollution Prevention Plan

The Contractor shall submit a Storm Water Notice of Intent (for NPDES coverage under the general permit for construction activities) and a Storm Water Pollution Prevention Plan (SWPPP) for the project to the COR prior and gain approval prior to the commencement of work. The SWPPP shall meet the requirements of the California State Water Resources Control Board's Construction General Permit (CAS000002). Submit the SWPPP along with any required Notice of Intents, Notice of Termination, and appropriate permit fees, via the COR, to the appropriate Federal or State agency (Notice of Intent and all applicable Permit Regulation Documents must be sent to California State Water Resources Control Board, along with appropriate fees) for approval, a minimum of 20 working days prior to the start of any land disturbing activities. The Contractor shall maintain an approved copy of the SWPPP at the construction on-site office, and continually update as regulations require, reflecting current site conditions. California now requires an Annual Report to be submitted by September 1st; an annual fee is also required.

Coverage under this permit requires the contractor prepare a Storm Water Pollution Prevention Plan (SWPPP), prepare and submit a Registration Statement as a co-permittee with the Construction Officer, and provide the permit fee to the responsible state agency before any land disturbing activities begin. The Environmental Management Division shall file the Notice of Intent for permit coverage and shall file the Notice of Termination once construction is complete. The contractor shall provide all documentation required to complete these Notices.

Under the terms and conditions of the permit, the Contractor may be required to install, inspect, maintain best management practices (BMPs), and submit stormwater BMP inspection reports and stormwater pollution prevention plan inspection reports. The Contractor shall ensure construction operations and management are constantly in compliance with the terms and conditions of the general permit for storm water discharges from construction activities.

a. The SWPPP shall:

1. Identify potential sources of pollution which may be reasonably expected to affect the quality of storm water discharge from the site.

2. Describe and ensure implementation of practices which will be used to reduce the pollutants in storm water discharge from the site.

3. Ensure compliance with terms of the EPA or State general permit for storm water discharge.

4. Select applicable best management practices from EPA 833-R-060-04.

5. Include a completed copy of the Registration Statement, BMP Inspection Report Template and Notice of Termination except for the effective date.

6. Storm Water Pollution Prevention Measures and Notice of Intent 40 CFR 122.26, EPA 833-R-060-04, and California Construction General Permit. Provide a "Storm Water Pollution Prevention Plan" (SWPPP) for the project. The SWPPP will meet the requirements of

the California State Water Resources Control Board Construction General Permit. Submit the SWPPP along with any required Notice of Intents, Notice of Termination, and appropriate permit fees, via the COR, to the appropriate Federal or State agency for approval, a minimum of 10 working days prior to the start of construction. A copy of the approved SWPPP will be kept at the construction on-site office, and continually updated as regulations require reflecting current site conditions.

3.2.2.2 Storm Water Pollution Prevention Plan Compliance Notebook

The contractor shall create and maintain a three binder of documents that demonstrate compliance with the Stormwater Construction Activity permit. The binder shall include a copy of the permit Registration Statement, proof of permit fee payment, SWPPP and SWPPP update amendments, inspection reports, copies of correspondence with the State Water Resources Control Board and a copy of the permit Notice of Termination. At the completion of the project the folder shall become the property of the Government. The compliance notebook shall be provided to COR. An advance copy of the Registration Statement shall be provided to the COR immediately after the form is presented to the permitting agency.

3.2.3 Stormwater Drainage and Construction Dewatering

There will be no discharge of excavation ground water to the sanitary sewer, storm drains, or to the river without prior specific authorization of the Environmental Division in writing. Discharge of hazardous substances will not be permitted under any circumstances.

Construction site runoff will be prevented from entering any storm drain or the river directly by the use of straw bales or other method suitable to the Environmental Division. Contractor will provide erosion protection of the surrounding soils.

Construction Dewatering shall not be discharged to the sanitary sewer. If the construction dewatering is noted or suspected of being contaminated, it may only be released to the storm drain system if the discharge is specifically permitted. Authorization for any contaminated groundwater release shall be obtained in advance from the base Environmental Officer. Discharge of hazardous substances will not be permitted under any circumstances.

3.3 HISTORICAL AND ARCHAEOLOGICAL RESOURCES

Carefully protect in-place and report immediately to the COR historical and archaeological items or human skeletal remains discovered in the course of work. Upon discovery, notify the COR. Stop work in the immediate area of the discovery until directed by the COR to resume work. The Government retains ownership and control over historical and archaeological resources.

3.4 SOLID WASTE MANAGEMENT PLAN and PERMIT

Provide to the COR written notification of the quantity of solid waste/debris that is anticipated to be generated by construction. Include in the report the locations where various types of waste will be disposed or recycled. Include letters of acceptance or as applicable, submit one copy of a State and local Solid Waste Management Permit or license showing such agency's approval of the disposal plan before transporting wastes off Government property.

3.4.1 Solid Waste Management Report

Monthly, submit a solid waste disposal report to the COR. For each waste, the report will state the classification (using the definitions provided in this section), amount, location, and name of the business receiving the solid waste.

The Contractor will include copies of the waste handling facilities' weight tickets, receipts, bills of sale, and other sales documentation. In lieu of sales documentation, the Contractor may submit a statement indicating the disposal location for the solid waste which is signed by an officer of the Contractor firm authorized to legally obligate or bind the firm. The sales documentation or Contractor certification will include the receiver's tax identification number and business, EPA or State registration number, along with the receiver's delivery and business addresses and telephone numbers. For each solid waste retained by the Contractor for his own use, the Contractor will submit on the solid waste disposal report the information previously described in this paragraph. Prices paid or received will not be reported to the COR unless required by other provisions or specifications of this Contract or public law.

3.4.2 Control and Management of Solid Wastes

Pick up solid wastes, and place in covered containers which are regularly emptied. Do not prepare or cook food on the project site. Prevent contamination of the site or other areas when handling and disposing of wastes. At project completion, leave the areas clean. Recycling is encouraged and can be coordinated with the COR and the activity recycling coordinator. Remove all solid waste (including non-hazardous debris) from Government property and dispose off-site at an approved landfill. Solid waste disposal off-site must comply with most stringent local, State, and Federal requirements including 40 CFR 241, 40 CFR 243, and 40 CFR 258.

Manage spent hazardous material used in construction, including but not limited to, aerosol cans, waste paint, cleaning solvents, contaminated brushes, and used rags, as per environmental law.

3.4.2.1 Dumpsters

Equip dumpsters with a secure cover and paint the standard base color. Keep cover closed at all times, except when being loaded with trash and debris. Locate dumpsters behind the construction fence or out of the public view. Empty site dumpsters at least once a week. or as needed to keep the site free of debris and trash. If necessary, provide 55 gallon trash containers painted the darker base color to collect debris in the construction site area. Locate the trash containers behind the construction fence or out of the public view. Empty trash containers at least once a day. For large demolitions, large dumpsters without lids are acceptable but should not have debris higher than the sides before emptying.

3.5 WASTE DETERMINATION DOCUMENTATION

Complete a Waste Determination form (provided at the pre-construction conference) for all contractor derived wastes to be generated. Base the waste determination upon either a constituent listing from the manufacturer used in conjunction with consideration of the process by which the waste was generated, EPA approved analytical data, or laboratory analysis (Material Safety Data Sheets (MSDS) by themselves are not adequate).

Attach all support documentation to the Waste Determination form. As a minimum, a Waste Determination form must be provided for the following wastes (this listing is not all inclusive): oil and latex based painting and caulking products, solvents, adhesives, aerosols, petroleum products, and all containers of the original materials.

3.6 CONTRACTOR HAZARDOUS MATERIAL INVENTORY LOG

Submit the "Contractor Hazardous Material Inventory Log"(found at: http://www.wbdg.org/ccb/NAVGRAPH/graphtoc.pdf), which provides information required by (EPCRA Sections 312 and 313) along with corresponding Material Safety Data Sheets (MSDS) to the COR at the start and at the end of construction (30 days from final acceptance), and update no later than January 31 of each calendar year during the life of the contract. Documentation for any spills/releases, environmental reports or off-site transfers may be requested by the COR.

3.6.1 Disposal Documentation for Hazardous and Regulated Waste

Manifest, pack, ship and dispose of hazardous or toxic waste and universal waste that is generated as a result of construction in accordance with the generating facilities generator status under the Recourse Conservation and Recovery Act. Contact the COR for the facility RCRA identification number that is to be used on each manifest.

Submit a copy of the applicable EPA and or State permit(s), manifest(s), or license(s) for transportation, treatment, storage, and disposal of hazardous and regulated waste by permitted facilities. Hazardous or toxic waste manifest must be reviewed, signed, and approved by the Environmental Management Division's authorized personnel before the Contractor may ship waste. To obtain specific disposal instructions the Contractor must coordinate with the Activity environmental office.

3.7 POLLUTION PREVENTION/HAZARDOUS WASTE MINIMIZATION

Minimize the use of hazardous materials and the generation of hazardous waste. Include procedures for pollution prevention/ hazardous waste minimization in the Hazardous Waste Management Section of the Environmental Management Plan. Consult with the activity Environmental Management Division for suggestions and to obtain a copy of the installation's pollution prevention/hazardous waste minimization plan for reference material when preparing this part of the plan. If no written plan exists, obtain information by contacting the COR. Describe the types of the hazardous materials expected to be used in the construction when requesting information.

3.8 WHM/HW MATERIALS PROHIBITION

No waste hazardous material or hazardous waste shall be disposed of on government property. No hazardous material shall be brought onto government property that does not directly relate to requirements for the performance of this contract. The government is not responsible for disposal of Contractor's waste material brought on the job site and not required in the performance of this contract. The intent of this provision is to dispose of that waste identified as waste hazardous material/hazardous waste as defined herein that was generated as part of this contract and existed within the boundary of the Contract limits and not brought in from offsite by the Contractor. Incidental materials used to support the contract including, but not limited to aerosol cans, waste

paint, cleaning solvents, contaminated brushes, rags, clothing, etc. are the responsibility of the Contractor. The list is illustrative rather than inclusive. The Contractor is not authorized to discharge any materials to sanitary sewer, storm drain, or to the river or conduct waste treatment or disposal on government property without written approval of the COR.

3.9 HAZARDOUS MATERIAL MANAGEMENT

No hazardous material shall be brought onto government property that does not directly relate to requirements for the performance of this contract.

Include hazardous material control procedures in the Safety Plan. Address procedures and proper handling of hazardous materials, including the appropriate transportation requirements. Submit a MSDS and estimated quantities to be used for each hazardous material to the COR prior to bringing the material on base. Typical materials requiring MSDS and quantity reporting include, but are not limited to, oil and latex based painting and caulking products, solvents, adhesives, aerosol, and petroleum products. At the end of the project, provide the COR with the maximum quantity of each material that was present at the site at any one time, the dates the material was present, the amount of each material that was used during the project, and how the material was used. Ensure that hazardous materials are utilized in a manner that will minimize the amount of hazardous waste that is generated. Ensure that all containers of hazardous materials have NFPA labels or their equivalent. Keep copies of the MSDS for hazardous materials on site at all times and provide them to the COR at the end of the project. Certify that all hazardous materials removed from the site are hazardous materials and do not meet the definition of hazardous waste per 40 CFR 261.

3.10 PETROLEUM PRODUCTS AND REFUELING

Conduct the fueling and lubricating of equipment and motor vehicles in a manner that protects against spills and evaporation. Manage all used oil generated on site in accordance with 40 CFR 279, State and Local regulations. Determine if any used oil generated while on-site exhibits a characteristic of hazardous waste. Used oil containing 1000 parts per million of solvents will be considered a hazardous waste and disposed of at Contractor's expense. Used oil mixed with a hazardous waste will also be considered a hazardous waste.

3.10.1 Oily and Hazardous Substances

Prevent oil or hazardous substances from entering the ground, drainage areas, or navigable waters. In accordance with 40 CFR 112, surround all temporary fuel oil or petroleum storage tanks with a temporary berm or containment of sufficient size and strength to contain the contents of the tanks, plus 10 percent freeboard for precipitation. The berm will be impervious to oil for 72 hours and be constructed so that any discharge will not permeate, drain, infiltrate, or otherwise escape before cleanup occurs.

3.10.2 Inadvertent Discovery of Petroleum Contaminated Soil or Hazardous Wastes

If petroleum contaminated soil or suspected hazardous waste is found during construction that was not identified in the contract documents, the contractor shall immediately notify the COR. The contractor shall not disturb this material until authorized by the COR.

3.11 FUEL TANKS

Petroleum products and lubricants required to sustain up to 30 days of construction activity may be kept on site. Storage and refilling practices shall comply with 40 CFR Part 112. Secondary containment shall be provided and be no less than 110 percent of the tank volume plus five inches of free-board. All fuel tanks with a fuel tank capacity of 10 or more gallons which will be on site for 72 hours or more must have a Temporary Fuel Tank Permit from Santa Clara County Department of Environmental Health Hazardous Materials Division. If a secondary berm is used for containment then the berm shall be impervious to oil for 72 hours and be constructed so that any discharge will not permeate, drain, infiltrate, or otherwise escape before cleanup occurs. Drips pans are required and the tanks must be covered during inclement weather.

3.12 RELEASES/SPILLS OF OIL AND HAZARDOUS SUBSTANCES

Exercise due diligence to prevent, contain, and respond to spills of hazardous material, hazardous substances, hazardous waste, sewage, regulated gas, petroleum, lubrication oil, and other substances regulated by environmental law. Maintain spill cleanup equipment and materials at the work site. In the event of a spill, take prompt, effective action to stop, contain, curtail, or otherwise limit the amount, duration, and severity of the spill/release. In the event of any releases of oil and hazardous substances, chemicals, or gases; immediately (within 15 minutes) notify the NASA Ames Research Center Dispatch and the COR. Call 911 from any NASA desk phone or (650)604-5555 from a mobile phone to reach NASA Ames Dispatch If the contractor's response is inadequate, the NASA Ames Research Center may respond. If this should occur, the contractor will be required to reimburse the government for spill response assistance and analysis.

Contain and clean up these spills without cost to the Government. If Government assistance is requested or required, the Contractor will reimburse the Government for such assistance. Provide copies of the written notification and documentation that a verbal notification was made within 20 days.

Maintain spill cleanup equipment and materials at the work site. Clean up all hazardous and non-hazardous waste spills. The Contractor shall reimburse the government for all material, equipment, and clothing generated during any spill cleanup. The Contractor shall reimburse the government for all costs incurred including sample analysis materials, equipment, and labor if the government must initiate its own spill cleanup procedures, for Contractor responsible spills, when:

a. The Contractor has not begun spill cleanup procedure within one hour of spill discovery/occurrence, or

b. If, in the government's judgment, the Contractor's spill cleanup is not adequately abating life threatening situation and/or is a threat to any body of water or environmentally sensitive areas.

3.13 CONTROL AND MANAGEMENT OF HAZARDOUS WASTES

3.13.1 Facility Hazardous Waste Generator Status

NASA Ames Research Center is designated as a Large Quantity Generator. All

work conducted within the boundaries of this activity must meet the regulatory requirements of this generator designation. The Contractor will comply with all provisions of Federal, State and local regulatory requirements applicable to this generator status regarding training and storage, handling, and disposal of all construction derived wastes.

3.13.2 Hazardous Waste/Debris Management

Identify all construction activities which will generate hazardous waste/debris. Provide a documented waste determination for all resultant waste streams. Hazardous waste/debris will be identified, labeled, handled, stored, and disposed of in accordance with all Federal, State, and local regulations including 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, and 40 CFR 268.

Hazardous waste will also be managed in accordance with the approved Hazardous Waste Management Section of the Environmental Protection Plan. Store hazardous wastes in approved containers in accordance with 49 CFR 173 and 49 CFR 178. Hazardous waste generated within the confines of Government facilities will be identified as being generated by the Government.

Prior to removal of any hazardous waste from Government property, all hazardous waste manifests must be signed by Environmental Management Division's authorized personnel. No hazardous waste will be brought onto Government property. Provide to the COR a copy of waste determination documentation for any solid waste streams that have any potential to be hazardous waste or contain any chemical constituents listed in 40 CFR 372-SUBPART D. For hazardous wastes spills, verbally notify the COR immediately.

3.13.2.1 Regulated Waste Storage/Satellite Accumulation/90 Day Storage Areas

If the work requires the temporary storage/collection of regulated or hazardous wastes, the Contractor will request the establishment of a Regulated Waste Storage Area, a Satellite Accumulation Area, or a 90 Day Storage Area at the point of generation. The Contractor must submit a request in writing to the COR providing the following information:

Contract Number	_____	Contractor	_____
Haz/Waste or Regulated Waste POC	_____	Phone Number	_____
Type of Waste	_____	Source of Waste	_____
Emergency POC	_____	Phone Number	_____

Location of the Site: _____
(Attach Site Plan to the Request)

Attach a waste determination form. Allow ten working days for processing this request. The designated area where waste is being stored shall be barricaded and a sign identifying as follows:

"DANGER OR CAUTION - UNAUTHORIZED PERSONNEL KEEP OUT"

3.13.2.2 Sampling and Analysis of HW

NASA Ames Research Center Environmental Management Division Hazardous Waster Program.

3.13.2.3 Hazardous Waste Disposal

No hazardous, toxic, or universal waste shall be disposed or hazardous material abandoned on government property. And unless otherwise other wise noted in this contract, the government is not responsible for disposal of Contractor generated waste material. The disposal of incidental materials used to accomplish the work including, but not limited to aerosol cans, waste paint, cleaning solvents, contaminated brushes, rags, clothing, etc. are the responsibility of the Contractor. The list is illustrative rather than inclusive.

The Contractor is not authorized to discharge any materials to sanitary sewer, storm drain, or water way or conduct waste treatment or disposal on government property without written approval of the COR.

Control of stored waste, packaging, sampling, analysis, and disposal will be determined by the details in the contract. The requirements for jobs in the following paragraphs will be used as the guidelines for disposal of any hazardous waste generated.

a. Responsibilities for Contractor's Disposal

Contractor responsibilities include any generation of WHM/HW requiring Contractor disposal of solid waste or liquid.

1. The Contractor agrees to provide all service necessary for the final treatment/disposal of the hazardous material/waste in accordance with all local, State and Federal laws and regulations, and the terms and conditions of the contract within sixty (60) days after the materials have been generated. These services will include all necessary personnel, labor, transportation, packaging, detailed analysis (if required for disposal, and/or transportation, including manifesting or completing waste profile sheets, equipment, and the compilation of all documentation is required).

2. Contain all waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, 40 CFR 268, 40 CFR 270, 40 CFR 272, 40 CFR 273, 40 CFR 279, 40 CFR 280, and 40 CFR 761.

3. Obtaining a representative sample of the material generated for each job done to provide waste stream determination.

4. Analyzing for each sample taken and providing analytical results to the COR. Provide two copies of the results.

5. Determine the DOT proper shipping names for all waste (each container requiring disposal) and will demonstrate how this determination is developed and supported by the sampling and analysis requirements contained herein to the COR.

<u>Contractor Disposal Turn-In Requirements</u>

For any waste hazardous materials or hazardous waste generated which requires the Contractor to dispose of, the following conditions must be complied with in order to be acceptable for disposal:

a. Drums compatible with waste contents and drums meet DOT requirements for 49 CFR 173 for transportation of materials.

b. Drums banded to wooden pallets. No more than three (3) 55 gallon drums to a pallet, or two (2) 85 gallon over packs.

c. Band using 1-1/4 inch minimum band on upper third of drum.

d. Recovery materials label (provided by Code 106.321) located in middle of drum, filled out to indicate actual volume of material, name of material manufacturer, other vendor information as available.

e. Always have three (3) to five (5) inches of empty space above volume of material. This space is called 'outage'.

3.13.3 Class I and II ODS Prohibition

Class I and II ODS as defined and identified herein will not be used in the performance of this contract, nor be provided as part of the equipment. This prohibition will be considered to prevail over any other provision, specification, drawing, or referenced documents. Regulations related to the protection of stratosphere ozone may be found in 40 CFR 82.

Heating and air conditioning technicians must be certified through an EPA-approved program. Copies of certifications shall be maintained at the employees' place of business and be carried as a wallet card by the technician, as provided by environmental law. Accidental venting of a refrigerant is a release and shall be reported to the COR.

3.13.3.1 Universal Waste/e-Waste Management

Universal waste including but not limited to some mercury containing building products such florescent lamps, mercury vapor lamps, high pressure sodium lamps, CRTs, batteries, aerosol paint containers, electrical equipment containing PCBs, and consumed electronic devices, shall be managed in accordance with applicable environmental law and installation instructions.

3.14 DUST CONTROL

Keep dust down at all times, including during nonworking periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning nonparticulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not unnecessarily shake bags of cement, concrete mortar, or plaster.

3.14.1 Dirt and Dust Control Plan

Submit truck and material haul routes along with a plan for controlling dirt, debris, and dust on base roadways. As a minimum, identify in the plan the subcontractor and equipment for cleaning along the haul route and measures to reduce dirt, dust, and debris from roadways.

3.15 ABRASIVE BLASTING

3.15.1 Blasting Operations

The use of silica sand is prohibited in sandblasting.

Blasting operations must follow the requirements of the Bay Area Air Quality Management District Regulation for Sandblasting, Regulation 12, Rule 4.

3.15.2 Disposal Requirements

Submit analytical results of the debris generated from abrasive blasting operations per paragraph entitled Laboratory Analysis of this section. Hazardous waste generated from blasting operations will be managed in accordance with paragraph entitled "Hazardous Waste\Debris Management" of this section and with the approved HWMP.

3.16 NOISE

Make the maximum use of low-noise emission products, as certified by the EPA. Blasting or use of explosives will not be permitted without written permission from the COR, and then only during the designated times. Confine pile-driving operations to the period between 8 a.m. and 4 p.m., Monday through Friday, exclusive of holidays, unless otherwise specified.

3.17 MERCURY MATERIALS

Mercury is prohibited in the construction of this facility, unless specified otherwise, and with the exception of mercury vapor lamps and fluorescent lamps. Dumping of mercury-containing materials and devices such as mercury vapor lamps, fluorescent lamps, and mercury switches, in rubbish containers is prohibited. Remove without breaking, pack to prevent breakage, and transport out of the activity in an unbroken condition for disposal as directed. Immediately report to the Environmental Office and the COR instances of breakage or mercury spillage. Clean mercury spill area to the satisfaction of the COR.

Cleanup of a mercury spill shall not be recycled and shall be managed as a hazardous waste for disposal.

-- End of Section --

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SECTION 01 62 35

RECYCLED / RECOVERED MATERIALS

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SECTION 01 62 35

RECYCLED / RECOVERED MATERIALS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for use of products containing recycled or recovered materials. Include a properly edited version of this guide specification in every design-bid-build and design-build project. EPA recycled content requirements must be addressed in all projects regardless of optional LEED/other recycled content goals.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.3 OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. Make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

1.4 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials. These items, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the

designated item requirements apply only if the designated item is used in the work.

1.5 EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

1.6 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

PART 2 TITLE

Not Used

PART 3 TITLE

Not Used

-- End of Section --

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SECTION 01 74 19

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for the management of non-hazardous construction and demolition waste materials.

1.2 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. A minimum of 50 percent by weight of total project solid waste shall be diverted from the landfill.

1.3 MANAGEMENT

Develop and implement a waste management program. Take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. The Environmental Manager, as specified in Section 01 35 40.00 20 Environmental Management, shall be responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the project. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor is responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained from salvage or recycling accrue to the Contractor. Appropriately permit firms and facilities used for recycling, reuse, and disposal for the intended use to the extent required by Federal, State, and local regulations. Also, provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Waste Management Plan

SD-11 Closeout Submittals

Records

1.5 WASTE MANAGEMENT PLAN

A Waste Management Plan shall be submitted within 15 days after notice to proceed and not less than 10 days before the pre-construction meeting. The plan shall demonstrate how the project waste diversion goal shall be met and shall include the following:

a. Name of individuals on the Contractor's staff responsible for waste prevention and management.

b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.

c. Description of the regular meetings to be held to address waste management.

d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.

e. Characterization, including estimated types and quantities, of the waste to be generated.

f. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.

g. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity. Include the name, location, and phone number for each reuse facility to be used, and provide a copy of the permit or license for each facility.

h. List of specific waste materials that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Recycling facilities that will be used shall be identified by name, location, and phone number, including a copy of the permit or license for each facility.

i. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by the COR.

j. Description of the means by which any waste materials identified in item (h) above will be protected from contamination.

k. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).

l. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

Revise and resubmit Plan as required by the COR. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. Distribute copies of the Waste Management Plan to each subcontractor, the Quality Control Manager, and the COR.

1.6 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Quantities may be measured by weight or by volume, but must be consistent throughout. List each type of waste separately noting the disposal or diversion date. Identify the landfill, recycling center, waste processor, or other organization used to process or receive the solid waste. Provide explanations for any waste not recycled or reused. With each application for payment, submit updated documentation for solid waste disposal and diversion, and submit manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. The records shall be made available to the COR during construction, and a copy of the records shall be delivered to the COR upon completion of the construction.

1.7 REPORTS

Provide quarterly reports and a final report to COR for review by Ames Environmental Management Division. Quarterly and final reports shall include project name, information for waste generated this quarter, and cumulative totals for the project. Each report shall include supporting documentation to include manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. Include timber harvest and demolition information, if any.

1.8 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvagability of identified materials. Provide the necessary containers, bins and storage areas to facilitate effective waste management and clearly and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations and coordinate with Section 01 35 40.00 20 ENVIRONMENTAL MANAGEMENT. Separate materials by one of the following methods:

1.8.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted as described below into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents,

petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the following category types as appropriate to the project waste and to the available recycling and reuse programs in the project area:

a. Land clearing debris.

b. Asphalt.

c. Concrete and masonry.

d. Metal (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, lead brass, bronze).

    1. Ferrous.

    2. Non-ferrous.

e. Wood (nails and staples allowed).

f. Debris.

g. Glass (colored glass allowed).

h. Paper.

    1. Bond.

    2. Newsprint.

    3. Cardboard and paper packaging materials.

i. Plastic.

    1. Type 1: Polyethylene Terephthalate (PET, PETE).

    2. Type 2: High Density Polyethylene (HDPE).

    3. Type 3: Vinyl (Polyvinyl Chloride or PVC).

    4. Type 4: Low Density Polyethylene (LDPE).

    5. Type 5: Polypropylene (PP).

    6. Type 6: Polystyrene (PS).

    7. Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

j. Gypsum.

k. Non-hazardous paint and paint cans.

l. Carpet.

m. Ceiling tiles.

n. Insulation.

o. Beverage containers.

1.8.2 Co-Mingled Method.

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

1.8.3 Other Methods.

Other methods proposed by the Contractor may be used when approved by the COR.

1.9 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the COR and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.9.1 Reuse

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Sale or donation of waste suitable for reuse shall be considered.

1.9.2 Recycle

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling. All fluorescent lamps, HID lamps, and mercury-containing thermostats removed from the site shall be recycled. Arrange for timely pickups from the site or deliveries to recycling facilities in order to prevent contamination of recyclable materials.

1.9.3 Compost

Consider composting on site if a reasonable amount of compostable material will be available. Compostable materials include plant material and sawdust. COR shall be contacted to discuss compositing options with Plant Engineering before composting.

1.9.4 Waste

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

1.9.5 Return

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

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SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for closeout submittals including: revised project documents, warranty management, testing, adjusting and balancing, O & M manuals, and final cleaning.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM E 1971	Stewardship for the Cleaning of Commercial and Institutional Buildings

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

As-Built Record of Equipment and Materials
Warranty Management Plan
Warranty Tags
Final Cleaning
Spare Parts Data

SD-08 Manufacturer's Instructions

Preventative Maintenance
Condition Monitoring (Predictive Testing)
Inspection
Posted Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

SD-11 Closeout Submittals

Record Drawings

Certification of EPA Designated Items
List of Warranties

1.4 PROJECT RECORD DOCUMENTS

1.4.1 Record Drawings

Drawings showing final as-built conditions of the project. This paragraph covers record drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working record drawings" and "final record drawings" refer to contract drawings which are revised to be used for final record drawings showing as-built conditions.

1.4.1.1 Government Furnished Plans

The Government will supply 2 full size sets of the contract drawings to the Contractor for use in the record drawings.

In cases where shop drawings are to be approved prior to construction a full-sized set of the approved shop drawings are to be maintained on site. This set will be considered to be part of the "Working Record" and "Final Record Drawings".

1.4.1.2 Working Record and Final Record Drawings

Revise 1 set of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. Keep these working as-built marked drawings current on a weekly basis and at least one set available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction must be accurately and neatly recorded as they occur by means of details and notes. Prepare final record (as-built) drawings after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked prints and final record (as-built) drawings will be jointly reviewed for accuracy and completeness by the COR and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final record drawings as specified herein, the COR will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the record drawings. This monthly deduction will continue until an agreement can be reached between the COR and the Contractor regarding the accuracy and completeness of updated drawings. Show on the working and final record drawings, but not limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, show by offset dimensions to two permanently fixed surface features the end of each run including each change in direction on the record drawings. Locate valves, splice boxes and similar appurtenances by dimensioning along the utility run from a reference point. Also record the average depth below the surface of each run.

b. The location and dimensions of any changes within the building structure.

c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

d. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

f. Changes or modifications which result from the final inspection.

g. Where contract drawings or specifications present options, show only the option selected for construction on the final as-built prints.

h. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, furnish a contour map of the final borrow pit/spoil area elevations.

i. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

j. Modifications (include within change order price the cost to change working and final record drawings to reflect modifications) and compliance with the following procedures.

   1. Follow directions in the modification for posting descriptive changes.

   2. Place a Modification Delta at the location of each deletion.

   3. For new details or sections which are added to a drawing, place a Modification Delta by the detail or section title.

   4. For minor changes, place a Modification Delta by the area changed on the drawing (each location).

   5. For major changes to a drawing, place a Modification Delta by the title of the affected plan, section, or detail at each location.

   6. For changes to schedules or drawings, place a Modification Delta either by the schedule heading or by the change in the schedule.

   7. The Modification Delta size shall be 1/2 inch across unless the area where the circle is to be placed is crowded. Smaller size deltas shall be used for crowded areas.

1.4.1.3 Drawing Preparation

Modify the record drawings as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints must be neat, legible and accurate. These drawings are part of the permanent records of this project and the original hardcopy must be returned to the COR after approval by the Government. Any drawings damaged

or lost by the Contractor must be satisfactorily replaced by the Contractor at no expense to the Government.

1.4.1.4 Payment

No separate payment will be made for record drawings required under this contract, and all costs accrued in connection with such drawings are considered a subsidiary obligation of the Contractor.

1.4.2 As-Built Record of Equipment and Materials

Submit the preliminary record of equipment and materials used on the project 10 working days prior to final inspection. Submit the final record of equipment and materials within 10 working days after final inspection. Key the designations to the related area depicted on the contract drawings. List the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA				
Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

1.4.3 Final Approved Shop Drawings

Furnish final approved project shop drawings that show the as-built conditions 20 working days after transfer of the completed facility.

1.4.4 Construction Contract Specifications

Furnish final record (as-built) construction contract specifications, including modifications thereto, 20 working days after transfer of the completed facility.

1.4.5 Real Property Equipment

Furnish a list of installed equipment furnished under this contract. Include all information usually listed on manufacturer's name plate. In the "EQUIPMENT-IN-PLACE LIST" include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. Furnish a draft list at time of transfer. Furnish the final list 20 working days after transfer of the completed facility.

1.5 SPARE PARTS DATA

Submit the Spare Parts Data list.

a. Indicate manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

b. Supply 2 of each part for spare parts inventory. Provision of spare

parts does not relieve the Contractor of responsibilities listed under the contract guarantee provisions.

1.6 PREVENTATIVE MAINTENANCE

Submit Preventative Maintenance, Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

a. Define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the schedule. Provide a signoff blank for the Contractor and COR for each test feature; e.g., gpm, rpm, psi. Include a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventative maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.7 CERTIFICATION OF EPA DESIGNATED ITEMS

Submit the Certification of EPA Designated Items as required by FAR 52.223-9, "Certification and Estimate of Percentage of Recovered Material Content for EPA Designated Items". Include on the certification form the following information: project name, project number, Contractor name, license number, Contractor address, and certification. The certification will read as follows and be signed and dated by the Contractor. "I hereby certify the information provided herein is accurate and that the requisition/procurement of all materials listed on this form comply with current EPA standards for recycled/recovered materials content. The following exemptions may apply to the non-procurement of recycled/recovered content materials: 1) The product does not meet appropriate performance standards; 2) The product is not available within a reasonable time frame; 3) The product is not available competitively (from two or more sources); 4) The product is only available at an unreasonable price (compared with a comparable non-recycled content product)." Record each product used in the project that has a requirement or option of containing recycled or biobased content in accordance with Section 01 62 35 RECYCLED/RECOVERED MATERIALS, noting total price, total value of post-industrial recycled content, total value of post-consumer recycled content, total value of biobased content, exemptions (1, 2, 3, or 4, as indicated), and comments. Recycled and biobased content values may be determined by weight or volume percent, but must be consistent throughout.

1.8 WARRANTIES

At least 20 working days before the contract completion date submit a List of Warranties that includes the following information:

a. Item Warranted

b. Length of Warranty

c. Point of contact for each warranty

1.8.1 Warranty Response Time

For each warranty there is a 24 hour response time. If the warrantor does not respond within 24 hours for an issue covered by a warranty the Government has the right to fix the problem and charge the warrantor for the resources spent to fix the problem.

1.9 MECHANICAL TESTING AND BALANCING

All contract requirements of Section 23 05 93 TESTING, ADJUSTING AND BALANCING must be fully completed, including testing and inspection, prior to contract completion date, except as noted otherwise in Section 23 05 93. The time required to complete all work and testing as prescribed by Section 23 05 93 and is included in the allotted days for completion.

1.10 OPERATION AND MAINTENANCE MANUALS

Submit three hardcopies and one electronic copy ofthe project operation and maintenance manuals 20 working days prior to testing the system involved. Update and resubmit data for final approval no later than 20 working days prior to contract completion.

1.10.1 Configuration

Operation and Maintenance Manuals must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. information shall be grouped by technical sections. Test data must be legible and of good quality. Organize data by separate index. Caution and warning indications must be clearly labeled.

1.10.2 Training and Instruction

Submit classroom and field instructions in the operation and maintenance of systems equipment where required by the technical provisions. These services must be directed by the Contractor, using the manufacturer's factory-trained personnel or qualified representatives. COR will be given 5 working days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor, such as lists, static exhibits, and visual aids, must be made available to the COR.

1.11 CLEANUP

Provide final cleaning in accordance with ASTM E 1971 and submit the listing of completed final clean-up items. Leave premises "broom clean." Use only nonhazardous cleaning materials, including natural cleaning materials, in the final cleanup. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Clean filters of operating equipment and comply with the Indoor Air Quality (IAQ) Management Plan. Clean debris from roofs, gutters, downspouts and drainage systems. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site. Recycle, salvage, and return construction and demolition

waste from project in accordance with the Waste Management Plan. Promptly and legally transport and dispose of any trash. Do not burn, bury, or otherwise dispose of trash on the project site.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

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SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for operation and maintenance (O&M) data normally shipped by a manufacturer at the same time as his associated piece of equipment is shipped. The requirements specified herein are intended to require those items of O&M data normally expected from the manufacturer of the associated equipment.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM E 1971	Stewardship for the Cleaning of Commercial and Institutional Buildings

1.3 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit three hard copies and three electronic copies of the Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The subcontractors shall compile and prepare data and deliver to the Contractor prior to the training of Government personnel. The Contractor shall compile and prepare aggregate O&M data including clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

1.3.1 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.3.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package

requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Commissioned items without a specified data package requirement in the individual technical sections shall use Data Package 4. Commissioned items with a Data Package 1 or 2 requirement shall use instead Data Package 3.

1.3.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the COR for final acceptance of submitted data, shall be submitted by the Contractor within 20 working days of the notification of this change requirement.

1.3.4 Review and Approval

The Government shall review the commissioned systems and equipment submittals for completeness and applicability. The Government shall verify that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. This work shall be in addition to the normal review procedures for O&M data.

1.4 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.4.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.4.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.4.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.4.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.4.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.4.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short

period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.4.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.4.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.4.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.4.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

1.4.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.4.2.3 Cleaning Recommendations

Provide environmentally preferable cleaning recommendations in accordance with ASTM E 1971.

1.4.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs for the installed model and features

of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.4.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.4.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.4.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.4.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.4.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.4.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.4.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.4.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.4.5.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

1.4.5.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.4.5.4 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog

1.4.5.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.4.5.6 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.4.5.7 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.4.5.8 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

1.4.5.9 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and

telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.5 TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES

Include Data Package 5 and the following for control systems:

a. Narrative description on how to perform and apply all functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.

b. Full as-built sequence of operations.

c. Copies of all checkout tests and calibrations performed by the Contractor (not Cx tests).

d. Full points list. A listing of rooms shall be provided with the following information for each room:

   1. Floor

   2. Room number

   3. Room name

   4. Air handler unit ID

   5. Reference drawing number

   6. Air terminal unit tag ID

   7. Heating and/or cooling valve tag ID

   8. Minimum cfm

   9. Maximum cfm

e. Full print out of all schedules and set points after testing and acceptance of the system.

f. Electronic copy of the entire as-built program for this facility.

g. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

1.6 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

1.6.1 Data Package 1

a. Safety precautions

b. Cleaning recommendations

c. Maintenance and repair procedures

d. Warranty information

e. Contractor information

f. Spare parts and supply list

1.6.2 Data Package 2

a. Safety precautions

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan and schedule

f. Cleaning recommendations

g. Maintenance and repair procedures

h. Removal and replacement instructions

i. Spare parts and supply list

j. Parts identification

k. Warranty information

l. Contractor information

1.6.3 Data Package 3

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Environmental conditions

g. Lubrication data

h. Preventive maintenance plan and schedule

i. Cleaning recommendations

j. Troubleshooting guides and diagnostic techniques

k. Wiring diagrams and control diagrams

l. Maintenance and repair procedures

m. Removal and replacement instructions

n. Spare parts and supply list

o. Product submittal data

p. O&M submittal data

q. Parts identification

r. Warranty information

s. Testing equipment and special tool information

t. Testing and performance data

u. Contractor information

1.6.4 Data Package 4

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Operator service requirements

g. Environmental conditions

h. Lubrication data

i. Preventive maintenance plan and schedule

j. Cleaning recommendations

k. Troubleshooting guides and diagnostic techniques

l. Wiring diagrams and control diagrams

m. Maintenance and repair procedures

n. Removal and replacement instructions

o. Spare parts and supply list

p. Corrective maintenance man-hours

q. Product submittal data

r. O&M submittal data

s. Parts identification

t. Warranty information

u. Personnel training requirements

v. Testing equipment and special tool information

w. Testing and performance data

x. Contractor information

1.6.5 Data Package 5

a. Safety precautions

b. Operator prestart

c. Start-up, shutdown, and post-shutdown procedures

d. Normal operations

e. Environmental conditions

f. Preventive maintenance plan and schedule

g. Troubleshooting guides and diagnostic techniques

h. Wiring and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Product submittal data

m. Manufacturer's instructions

n. O&M submittal data

o. Parts identification

p. Testing equipment and special tool information

q. Warranty information

r. Testing and performance data

s. Contractor information

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for Reliability Centered Building and Equipment Acceptance for Mechanical systems.

1.2 SYSTEM DESCRIPTION

This specification establishes acceptance requirements to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that will shorten the design life of the equipment. These requirements utilize Predictive Testing & Inspection (PT&I) technologies and are essential elements in the Government's Reliability Centered Building and Equipment Acceptance Program.

This specification is not intended to limit the inspection and acceptance process to the use of PT&I techniques. This guide is intended to supplement comprehensive and detailed commissioning and quality control specifications.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan

Material, Equipment, and Fixture Lists

SD-02 Shop Drawings

Connection Diagrams

Bearing Layout

Fabrication Drawings

Installation Drawings

SD-03 Product Data

Manufacturer's Catalog Data

Equipment Foundation Data

Specific Equipment Data

Spare Parts List

Warranty

SD-05 Design Data

Design Analysis and Calculations

SD-06 Test Reports

Alignment Test

Balancing Test

Code and Requirements Verification Test

Cold Starting Test

Ductwork Leakage Test

Flux Analysis Test

High Voltage Test

Hydraulic Oil Test

Hydrostatic Test

Infrared Thermography Test

Insulation Power Factor Test

Insulation Resistance Test

Motor Circuit Evaluation Test

Thermodynamic Performance Test

Ultrasonic (Airborne) Test

Ultrasonic (Pulse) Test

Vibration Analysis Test

Visual Inspection

Warranty Test

SD-07 Certificates

Certificates

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

SD-10 Operation and Maintenance Data

Operations and Maintenance Manuals

SD-11 Closeout Submittals

Record Drawings

Acceptance Documentation

1.5 DESIGN DATA

Submit applicable design analysis and calculations for the equipment listed below as instructed to by the project specification.

a. Blowers

b. Boilers

c. Gearboxes

d. Fans

e. Fluid Piping

f. Heat Exchangers

g. HVAC Ducts

h. Miscellaneous Safety Wash

i. Motors

j. Pumps

k. Valves

l. Steam Traps

1.6 QUALITY ASSURANCE

Submit a Quality Control plan outlining the intended methods of receiving, testing, and installing equipment. The RCBEA GUIDE specifies minimum test equipment requirements. Use trained and adequately certified personnel in the appropriate acceptance testing PT&I technologies to ensure that the results are accurate and consistent. Submit the following as part of the

quality control plan for all required acceptance testing:

a. List of all test equipment used, including its manufacturer, model number, calibration date, certificate of calibration, and serial number.

b. Certificates of test personnel qualifications and certifications.

1.7 WARRANTY

Furnish workmanship and performance warranty for the work performed for a period not less than 1 year from the date of Government acceptance of the work; issued directly to the Government. Perform corrective action that becomes necessary because of defective materials and workmanship while system is under warranty 7 days after notification, unless additional time is approved by the COR. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the Contractor. Provide a 1 year minimum contractor installation warranty.

PART 2 PRODUCTS

2.1 PRODUCT DATA

Submit material, equipment, and fixture lists for all equipment, materials, and fixtures planned for use to complete the job before commencing work. Include at a minimum, the item's description, quantity, manufacturer's style or catalog numbers, and specification and drawing reference numbers. Provide a complete list of construction equipment to be used.

2.1.1 Manufacturer Product Data

Submit fabrication drawings for equipment and specialties consisting of fabrication and assembly details to be performed in the factory. Show cutaway and sectional views in gearbox fabrication drawings.

Submit data for all equipment listed in the paragraph entitled, "Product Data," of this section. Include manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, equipment performance data charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit for each specified component.

Submit bearing layout drawings detailing the type, size, and orientation of bearings for equipment containing bearings, such as motors, pumps, fans, cranes, gearboxes, etc.

Submit for all equipment listed in the paragraph entitled, "Product Data," of this section. Include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

Submit manufacturer's catalog data and equipment foundation data for the following equipment:

a. Blowers

b. Boilers

c. Fans

d. Fluid Piping

e. Heat Exchangers

f. HVAC Ducts

g. Miscellaneous Safety Wash

h. Motors

i. Pumps

j. Valves

k. Steam Traps

2.1.2 Certification Data

Submit applicable certificates for the equipment listed below showing conformance with test requirements, laboratory certifications, etc. as instructed by the project specification.

a. Blowers

b. Boilers

c. Fans

d. Fluid Piping

e. Heat Exchangers

f. HVAC Ducts

g. Miscellaneous Safety Wash

h. Motors

i. Pumps

j. Valves

k. Steam Traps

2.1.3 Specific Equipment Data

Submit the following information for all equipment listed below: location of installation, AIR FORCE ARMY NASA NAVY Identification number, date of installation (required or actual acceptance date), and applicable AIR FORCE ARMY NASA NAVY reference drawing number. Unless explicitly stated in submitted manufacturer's literature, provide and submit the following specific equipment data:

a. Blowers

1. Blower type

2. Number of rotating vanes

3. Number of stationary vanes

4. Rotating Speed(s)

5. Number of belts (if belt driven)

6. Belt lengths - measured at the pitch line (if belt driven)

7. Diameter of the drive sheave at the drive pitch line (if belt driven)

8. Diameter of the driven sheave at the drive pitch line (if belt driven)

b. Boilers

1. Boiler type

c. Fans

1. Fan type

2. Number of rotating fan blades/vanes

3. Number of stationary fan blades/vanes

4. Rotating Speed(s)

5. Number of belts (if belt driven)

6. Belt lengths - measured at the pitch line (if belt driven)

7. Diameter of the drive sheave at the drive pitch line (if belt driven)

8. Diameter of the driven sheave at the drive pitch line (if belt driven)

d. Fluid Piping

1. Pipe material

2. Pipe size and schedule

d. Heat Exchangers

1. Heat Exchanger type

e. HVAC Ducts

1. Type of duct installed

f. Miscellaneous Safety Wash

1. Type

g. Motors

1. Motor type

2. Bearing information

3. Frame size

4. Motor class

5. Full load and locked rotor current

6. Winding resistance

7. Winding inductance

8. Cooling fan blades

9. Number of rotor bars

10. Number of stator slots

11. SCR firing sequence

h. Pumps

1. Pump type

2. Number of stages

3. Number of vanes per stage

4. Number of gear teeth on each pump gear

5. Type of impeller or gear

6. Rotating speed

7. Number of volutes

8. Number of diffuser vanes

i. Steam Traps

1. Steam trap type

j. Valves

1. Valve type

2.1.4 Extra Materials

Submit spare parts list data for each different item of material and equipment specified, after approval of detail drawings and not later than 2 months prior to the date of project acceptance. Include in the data a

complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 12 months operation, and a list of the parts recommended by the manufacturer to be replaced after 5 year(s) of service.

PART 3 EXECUTION

3.1 INSTALLATION

Submit installation drawings for all installed equipment consisting of equipment layouts including assembly, applicable manufacturer's instructions, installation details and electrical connection diagrams; layout and installation details including support structures, piping and related system components. Include on the drawings any information required to demonstrate that the system has been coordinated and will properly function within the HVAC or boiler plant system, and show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

Submit connection diagrams for equipment, pipes, valves and specialties indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit record drawings, at least 14 days after completion of equipment installation and acceptance testing. Update mechanical system drawings to reflect final record as-built conditions after all related work is completed.

3.2 EXAMINATION

Perform visual inspection on the equipment listed below. Correct all abnormalities or defects as directed by the COR.

a. Blowers

b. Boilers

c. Fans

d. Fluid Piping

e. Heat Exchangers

f. HVAC Ducts

g. Miscellaneous Safety Wash

h. Motors

i. Pumps

j. Valves

k. Steam Traps

3.3 FIELD QUALITY CONTROL AND ACCEPTANCE TESTING

Deliver equipment and services that meet the contract requirements and specifications. The Government desites that all such equipment be free of latent manufacturing and installation defects, and acceptance criteria is defined to ensure, to the maximum extent possible within economic reason, that these criteria are met. Perform acceptance testing as defined in this specification and the RCBEA GUIDE, using both traditional and PT&I technologies. The Government will observe and monitor the acceptance testing, analysis and documentation as part of the Government's Quality Assurance Program. Not until the requirements of acceptance are met will the equipment or facility be accepted by the Government.

3.3.1 Predictive Testing and Inspection

Perform the following PT&I Tests in accordance with the requirements and criteria established in the RCBEA GUIDE. Include test point locations in all submitted reports.

Provide final test reports to the COR. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words " Final Test Report Data - Forward to the Predictive Testing Group for inclusion in the Maintenance Information Database".

a. Perform alignment test for:

    1. Blowers (laser preferred)

    2. Fans (laser preferred)

    3. Motors (laser preferred)

    4. Pumps (laser preferred)

b. Perform balancing test for:

    1. Blowers

    2. Fans

    3. Motors

    4. Pumps

c. Perform code and requirements verification test for:

    1. Miscellaneous Safety Wash

d. Perform cold starting test for:

    1. Motors

e. Perform ductwork leakage test for:

    1. HVAC Ducts

f. Perform flux analysis test for:

    1. Motors

g. Perform high voltage test for:

1. Motors

h. Perform hydraulic oil test for:

2. Pumps

i. Perform hydrostatic test for:

1. Boilers

2. Fluid Piping

3. Heat Exchangers

4. Valves

j. Perform infrared thermography test for:

1. Fans

2. HVAC Ducts

3. Pumps

4. Boilers

5. Fluid Piping

6. Heat Exchangers

7. Motors

8. Valves

k. Perform insulation power factor test for:

1. Motors

l. Perform insulation resistance test for:

1. Motors

m. Perform lubricating oil test for:

1. Blowers

2. Fans

3. Motors

4. Pumps

n. Perform motor circuit evaluation test for:

1. Motors

o. Perform thermodynamic performance test for:

1. Blowers
2. Boilers
3. Fans
4. Fluid Piping
5. Heat Exchangers
6. HVAC Ducts
7. Pumps
8. Valves

p. Perform ultrasonic (airborne) test for:

1. Boilers
2. Fans
3. HVAC Ducts
4. Motors
5. Pumps
6. Steam Traps

q. Perform ultrasonic (pulse) test for:

1. Fluid Piping
2. Heat Exchangers

z. Perform vibration analysis test for:

1. Blowers
2. Fans
3. Motors
4. Pumps

3.4 OPERATIONS AND MAINTENANCE

Submit manufacturer's operations and maintenance manuals for the following equipment:

a. Blowers

b. Boilers

c. Fans

d. Fluid Piping

e. Heat Exchangers

f. HVAC Ducts

g. Miscellaneous Safety Wash

h. Motors

i. Pumps

j. Valves

k. Steam Traps

Submit six complete copies of operations and maintenance manuals in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown. Include the manufacturer's name, model number, parts list, routine maintenance procedures, possible breakdowns and repairs, trouble shooting guide, and a brief description of all equipment and their basic operating features. Include piping and equipment layouts and simplified wiring and control diagrams of the system as installed. Where available, provide technical manuals in electronic format with Standard Graphics Markup Language. When electronic format publications are provided, only three copies of the document are required. Submit operations and maintenance manuals 30 calendar days prior to testing any equipment.

3.5 ACCEPTANCE DOCUMENTATION

Upon completion of the project and acceptance testing the COR will provide acceptance documentation to the Contractor. Complete, sign and date this documentation and submit back to the COR for processing and approval.

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2.1.3 Specific Equipment Data
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PART 3 EXECUTION

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3.3.2 Baseline Data from Verification Testing
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SECTION 01 86 26.07 40

RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for Reliability Centered Building and Equipment Acceptance for Electrical systems.

1.2 SYSTEM DESCRIPTION

This specification establishes acceptance requirements to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that will shorten the design life of the equipment. These requirements utilize Predictive Testing & Inspection (PT&I) technologies and are essential elements in the Government's Reliability Centered Building and Equipment Acceptance Program.

This specification is not intended to limit the inspection and acceptance process to the use of PT&I techniques. This guide is intended to supplement comprehensive and detailed commissioning and quality control specifications.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan

Material, Equipment, and Fixture Lists

SD-02 Shop Drawings

Connection Diagrams

Fabrication Drawings

Installation Drawings

SD-03 Product Data

Manufacturer's Catalog Data

Equipment Foundation Data

Specific Equipment Data

Spare Parts List

Warranty

SD-05 Design Data

Design Analysis and Calculations

SD-06 Test Reports

Air Compressor Performance Test

Breaker Timing Test

Contact Resistance Test

Continuity Test

Fall of Potential Test

General Battery Test

General Charger Test

Insulation Resistance Test

Overpotential Test

Point to Point Test

Power Factor Test

Turns Ratio Test

Visual Inspection

SD-07 Certificates

Certificates

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

SD-10 Operation and Maintenance Data

Operations and Maintenance Manuals

SD-11 Closeout Submittals

Acceptance Documentation

Record Drawings

Baseline Data Report

1.5 DESIGN DATA

Submit applicable design analysis and calculations for the equipment listed below as instructed to by the project specification.

a. Breakers:

1. General

B. Cables:

1. General

2. Low Voltage (600V Maximum)

3. Medium Voltage (600V-33,000V)

c. Electric Buss

d. Electrical Control Panels

e. Electrical Distribution Panels

f. Electrical Grounding Grid

g. Electrical Lightning Protection

h. Electrical Power Centers

i. Electrical Power Supplies

j. Electrical Relays

k. Electrical Starters

l. Motor Control Centers

m. Switchboard

n. Transformers

1.6 QUALITY ASSURANCE

Submit a Quality Control plan outlining the intended methods of receiving, testing, and installing equipment. The RCBEA GUIDE specifies minimum test equipment requirements. Use trained and adequately certified personnel in the appropriate acceptance testing PT&I technologies to ensure that the results are accurate and consistent. Submit the following as part of the

quality control plan for all required acceptance testing:

a. List of all test equipment used, including its manufacturer, model number, calibration date, certificate of calibration, and serial number.

b. Certificates of test personnel qualifications and certifications.

1.7 WARRANTY

Furnish workmanship and performance warranty for the work performed for a period not less than 1 years from the date of Government acceptance of the work; issued directly to the Government. Perform corrective action that becomes necessary because of defective materials and workmanship while system is under warranty 7 days after notification, unless additional time is approved by the COR. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the Contractor. Provide a 1 year minimum contractor installation warranty.

PART 2 PRODUCTS

2.1 PRODUCT DATA

Submit material, equipment, and fixture lists for all equipment, materials, and fixtures planned for use to complete the job before commencing work. Include at a minimum, the item's description, quantity, manufacturer's style or catalog numbers, and specification and drawing reference numbers. Provide a complete list of construction equipment to be used.

2.1.1 Manufacturer Product Data

Submit fabrication drawings for equipment and specialties consisting of fabrication and assembly details to be performed in the factory. Show connection diagrams and assemblies in switchgear fabrication drawings

Submit for all equipment listed. Include manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, equipment performance data charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit for each specified component.

Submit manufacturer's catalog data and equipment foundation data (as applicable) for the following equipment:

Include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

a. Breakers:

    1. General

b. Cables:

1. General

2. Low Voltage (600V Maximum)

3. Medium Voltage (600V-33,000V)

c. Electric Buss

d. Electrical Control Panels

e. Electrical Distribution Panels

f. Electrical Grounding Grid

g. Electrical Lightning Protection

h. Electrical Power Centers

i. Electrical Power Supplies

j. Electrical Relays

k. Electrical Starters

l. Motor Control Centers

m. Switchboard

n. Transformers

2.1.2 Certification Data

Submit applicable certificates for the equipment listed below showing conformance with test requirements, laboratory certifications, etc. as instructed by the project specification.

a. Breakers:

1. General

b. Cables:

1. General

2. Low Voltage (600V Maximum)

3. Medium Voltage (600V-33,000V)

c. Electric Buss

d. Electrical Control Panels

e. Electrical Distribution Panels

f. Electrical Grounding Grid

g. Electrical Lightning Protection

h. Electrical Power Centers

i. Electrical Power Supplies

j. Electrical Relays

k. Electrical Starters

l. Motor Control Centers

m. Switchboard

n. Transformers

2.1.3 Specific Equipment Data

Submit the following information for all equipment listed below: location of installation, AIR FORCE ARMY NASA NAVY Identification number, date of installation (required or actual acceptance date), and applicable AIR FORCE ARMY NASA NAVY reference drawing number. Unless explicitly stated in submitted manufacturer's literature, provide and submit the following specific equipment data:

a. Breakers- General, Air Blast, Air Magnetic, Oil, SF6 Gas, and Vacuum Types

    1. Breaker type

    2. Breaker Specifications (including current transformer ratios)

b. Cables- Low, Medium, and High Voltage

    1. Power cable type

c. Electric Buss

    1. Buss Type

    2. Buss Specifications (including current and load capacity)

d. Electrical Control Panel

    1. Electrical Control Panel Type (NEMA enclosure type)

    2. Voltage configuration (120/240 VAC, 12/24 VDC, etc.)

    3. Amperage

    4. Dimensions

    5. Weight

    6. UL certification

    7. EMI levels (if applicable)

d. Electrical Distribution Panel

    1. Electrical Control Panel Type (NEMA enclosure type)

2. Voltage configuration (120/240 VAC, 12/24 VDC, etc.)

3. Amperage (panel main bus maximum)

4. Dimensions

5. Weight

6. UL certification

7. EMI levels (if applicable)

8. Number of circuit breaker positions (outputs)

9. Electrical Distribution Panel impedance

e. Electrical Grounding Grid

1. Grid Identification (Type)

f. Electrical Lightning Protection

1. Electrical Lightning Protection for Type I or II building structures

2. Class I Type Structures (Buildings below 75 feet in height)

3. Class I & Class II Type Structures where the structural steel will be used in lieu of downlead or vertical cables

4. Electrical Lightning Protection Specifications: UL certification - “Master Label” rating by a UL inspector

5. Installation configuration

g. Electrical Power Centers

1. Electrical power center type (NEMA enclosure type)

2. Voltage configuration (120/240 VAC, 12/24 VDC, etc.)

3. Amperage (panel main bus maximum)

4. Dimensions

5. Weight

6. UL certification

7. EMI levels (if applicable)

8. Number of circuit breaker positions (outputs)

9. Electrical power center impedance

g. Electrical Power Supplies

1. Electrical power supply type

2. DC Output ratings

3. Dimensions, Weight

4. UL certification, EMI levels (if applicable)

5. Electrical Power Supply impedance

h. Electrical Relays

1. Electrical relay type (NEMA enclosure type)

2. Voltage configuration

3. Time over current curves (time delay curves)

4. Phase and ground operating curves (shapes)

5. Dimensions, Weight

6. UL certification, EMI levels (if applicable)

7. Number and types of output relays

8 Current loading

i. Electrical Starters

1. Electrical Starter Type (NEMA enclosure type)

2. Amperage and voltage configuration (25A-60A, <600V and ¼-50HP, etc.)

3. Overload settings

4. Dimensions, Weight

5. UL certification, EMI levels (if applicable)

j. Electric Switch, All Types

1. Switch type

2. Switch specifications

k. Motor Control Center

1. Motor control center type

2. Motor control center specifications

l. Switchgear

1. Switchgear type

2. Switchgear specification data (voltage rating)

m. Transformers

1. Transformer Type

2. Winding resistance

3. Current transformer ratios

4. Transformer impedance

5. Load loss at rated voltage and current

6. Current loading

2.1.4 Extra Materials

Submit spare parts list data for each different item of material and equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 12 months operation, and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

PART 3 EXECUTION

3.1 INSTALLATION

Submit installation drawings for all installed equipment consisting of equipment layouts including assembly, applicable manufacturer's instructions, installation details and electrical connection diagrams; layout and installation details including support structures, conduit and related system components. Include on the drawings any information required to demonstrate that the system has been coordinated and will properly function within the electrical system, and show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

Submit connection diagrams for electrical equipment, panels, conduit, and specialties indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit record drawings, at least 14 days after completion of equipment installation and acceptance testing. Update electrical system drawings to reflect final record as-built conditions after all related work is completed.

3.2 EXAMINATION

Perform visual inspection on the equipment listed below. Correct all abnormalities or defects as directed by the COR.

a. Breakers:

1. General

2. Air Blast

3. Air Magnetic

b. Cables:

1. General

2. Low Voltage (600V Maximum)

3. Medium Voltage (600V-33,000V)

c. Electric Buss

d. Electrical Control Panels

e. Electrical Distribution Panels

f. Electrical Grounding Grid

g. Electrical Lightning Protection

h. Electrical Power Centers

i. Electrical Power Supplies

j. Electrical Relays

k. Electrical Starters

l. Motor Control Centers

m. Switchboard

n. Transformers

3.3 FIELD QUALITY CONTROL AND ACCEPTANCE TESTING

Deliver equipment and services that meet the contract requirements and specifications. Ensure all equipment is free of latent manufacturing and installation defects, and acceptance criteria are met. Perform acceptance testing as defined in this specification and the RCBEA GUIDE, using both traditional and PT&I technologies. The Government will observe and monitor the acceptance testing, analysis and documentation as part of the Government's Quality Assurance Program. Not until the requirements of acceptance are met will the equipment or facility be accepted by the Government.

3.3.1 Predictive Testing and Inspection Tests

Perform the following PT&I Tests in accordance with the requirements and criteria established in the RCBEA GUIDE. Include test point locations in all submitted reports.

Provide final test reports to the COR. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Report Data - Forward to the Predictive Testing Group for inclusion in the Maintenance Information Database.

a. Perform Breaker Timing Test for:

1. Breakers- General optional

2. Breakers- Air Blast optional

3. Breakers- Air Magnetic optional

b. Perform Contact Resistance Test for:

1. Breakers- General

2. Electric Buss

3. Electrical Control Panel

4. Electrical Distribution Panel

5. Electrical Power Centers

6. Electrical Power Supplies

7. Electric Switch, Low Voltage Air

8. Electrical Relays

9. Electrical Starters

10. Switchboard

11. Transformers optional

c. Perform Continuity Test for:

1. Electrical Lightning Protection

d. Perform Fall of Potential Test for:

1. Electrical Grounding Grid

e. Perform Infrared Thermography Test for:

1. Electrical Control Panels

2. Electrical Distribution Panel

3. Electrical Power Centers

4. Electrical Power Supplies

5. Electrical Starters

6. Motor Control Center

7. Switchboard

8. Transformers

9. Breakers- General optional

10. Electric Buss optional

11. Electric Switch, Low Voltage Air optional

f. Perform Insulation Oil Test for:

1. Breakers- General

g. Perform Insulation Resistance Test for:

1. Breakers- General
2. Cables (General)
3. Cables- Low Voltage (600V Maximum)
4. Cables- Medium Voltage (600V-33,000V)
5. Electric Buss
6. Electrical Relays
7. Switchboard
8. Electrical Control Panel
9. Electrical Distribution Panel
10. Electrical Lightning Protection
11. Electrical Power Centers
12. Electrical Power Supplies
13. Electrical Starters
14. Motor Control Centers
15. Transformers

h. Perform Overpotential Test for:

1. Capacitor, Dry-Type
2. Electric Buss

i. Perform Point to Point Test for:

1. Electrical Grounding Grid

j. Perform Power Factor Test for:

1. Transformers
2. Breakers- General
3. Cables (General)
4. Cables- Medium Voltage (600V-33,000V)
5. Electrical Control Panel

6. Electrical Distribution Panel

7. Electrical Power Centers

8. Electrical Power Supplies

9. Switchboard

k. Perform Turns Ratio Test for:

1. Transformers

l. Perform Ultrasonic (Airborne) Test for:

1. Electrical Control Panel

2. Electrical Distribution Panel

3. Electrical Power Centers

4. Electrical Starters

5. Motor Control Centers

6. Switchboard

7. Transformers

8. Breakers- General

9. Cables (General)

10. Cables- Low Voltage (600V Maximum)

11. Cables- Medium Voltage (600V-33,000V)

12. Electric Buss

3.3.2 Baseline Data from Verification Testing

Upon completion of all PT&I tests submit baseline data report to the COR. Include a summary of all performance data, set points, operating parameters and PT&I test results obtained for equipment and building systems.

3.4 OPERATIONS AND MAINTENANCE

Submit manufacturer's operations and maintenance manuals for the following equipment:

a. Breakers:

1. General

b. Cables:

1. General

2. Low Voltage (600V Maximum)

3. Medium Voltage (600V-33,000V)

c. Electric Buss

d. Electrical Control Panels

e. Electrical Distribution Panels

f. Electrical Grounding Grid

g. Electrical Lightning Protection

h. Electrical Power Centers

i. Electrical Power Supplies

j. Electrical Relays

k. Electrical Starters

l. Motor Control Centers

m. Switchboard

n. Transformers

Submit six complete copies of operations and maintenance manuals in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown. Include the manufacturer's name, model number, parts list, routine maintenance procedures, possible breakdowns and repairs, trouble shooting guide, and a brief description of all equipment and their basic operating features. Include piping and equipment layouts and simplified wiring and control diagrams of the system as installed. Where available, provide technical manuals in electronic format with Standard Graphics Markup Language. When electronic format publications are provided, only two copies of the document are required. Submit operations and maintenance manuals 30 calendar days prior to testing any equipment.

3.5 ACCEPTANCE DOCUMENTATION

Upon completion of the project and acceptance testing the COR will provide acceptance documentation to the Contractor. Complete, sign and date this documentation and submit back to the COR for processing and approval.

-- End of Section --

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SECTION 02 41 00

DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for demolition, deconstructon, dismantling, reconditioning and disposal of existing building materials, equipment and utilities as a part of new construction or renovation work.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI Guideline K	Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6	Safety Requirements for Demolition Operations

CARPET AND RUG INSTITUTE (CRI)

CRI 104	Standard for Installation Specification of Commercial Carpet

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	Safety and Health Requirements Manual

U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25	Storage and Handling of Liquefied and Gaseous Compressed Gases and Their Full and Empty Cylinders

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M	MILSTRIP - Military Standard Requisitioning and Issue Procedures
MIL-STD-129	Military Marking for Shipment and Storage

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 82	Protection of Stratospheric Ozone
49 CFR 173.301	Shipment of Compressed Gases in Cylinders and Spherical Pressure Vessels

1.3 PROJECT DESCRIPTION

1.3.1 Demolition

Prepare a Demolition Plan and submit proposed salvage, demolition, and removal procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, and if required a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Identify components and materials to be salvaged for reuse or recycling with reference to paragraph Existing Facilities to be Removed. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use. Coordinate with Waste Management Plan. Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by COR prior to work beginning.

1.3.2 General Requirements

Do not begin demolition or until authorization is received from the COR. The work of this section is to be performed in a manner that maximizes salvage and recycling of materials. Remove rubbish and debris from the project site daily; do not allow accumulations inside or outside the buildings on airfield pavements. The work includes demolition, , salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the COR. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.4 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the COR. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements to remain. Provide new supports and reinforcement for existing construction weakened by demolition, or removal work. Repairs, reinforcement, or structural replacement require approval by the COR prior

to performing such work.

1.4.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

1.4.2 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed roof areas.

1.4.3 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and operations. Prior to start of work, utilities serving each area of alteration or removal will be shut off by the Government and disconnected and sealed by the Contractor .

1.4.4 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the COR. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted. Where burning is permitted, adhere to federal, state, and local regulations.

1.6 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available in accordance with a schedule to be provided by the COR.

1.7 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions

SD-07 Certificates

Demolition Plan
Notification of Demolition and Renovation form

SD-11 Closeout Submittals

Receipts

1.8 QUALITY ASSURANCE

Submit timely notification of demolition and renovation projects to the COR and local authorities as necessary in accordance with 40 CFR 61, Subpart M. Notify the Regional Office of the United States Environmental Protection Agency (USEPA) State's environmental protection agency local air pollution control district/agency and the COR in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

1.8.1 Dust and Debris Control

Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Vacuum and dust the work area daily.

1.9 PROTECTION

1.9.1 Traffic Control Signs

a. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Anchor barricades in a manner to prevent displacement by wind. Notify the COR 10 days prior to beginning such work.

1.9.2 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.10 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair or replace items to be relocated which are damaged by the Contractor with new undamaged items as approved by the COR.

1.11 EXISTING CONDITIONS

Before beginning any demolition or work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the COR showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document. Submit survey results.

PART 2 PRODUCTS

2.1 FILL MATERIAL

a. Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill basements, voids, depressions or excavations resulting from demolition or of structures. Fill material shall be waste products from demolition or until all waste appropriate for this purpose is consumed.

b. Fill material shall conform to the definition of satisfactory soil material as defined by ASTM D 2487 in accordance with Section 31 00 00 Earthwork. In addition, fill material shall be free from roots and other organic matter, trash, debris, frozen materials, and stones larger than 2 inches in any dimension.

c. Proposed fill material must be sampled and tested by an approved soil testing laboratory in accordance with Section 31 00 00 Earthwork.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures onsite for reuse. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse onsite whenever possible.

3.1.1 Structures

a. Remove existing structures indicated to be removed to the level indicated on the Drawings. Interior walls, other than retaining walls and partitions, shall be removed to the level shown on the Drawings. Break up basement slabs to permit drainage. Remove sidewalks, curbs, gutters and street light bases as indicated.

b. Demolish structures in a systematic manner from the top of the structure to the ground. Complete demolition work above each tier or floor before the supporting members on the lower level are disturbed. Demolish concrete and masonry walls in small sections. Remove structural framing members and lower to ground by means of derricks,

platforms hoists, or other suitable methods as approved by the COR.

c. Locate demolition and equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

3.1.2 3.1.2 Utilities and Related Equipment

3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the COR. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition or work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.2.2 Disconnecting Existing Utilities

Remove existing utilities , as indicated and uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the COR. When utility lines are encountered but are not indicated on the drawings, notify the COR prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the COR.

3.1.3 Chain Link Fencing

Remove chain link fencing, gates and other related salvaged items scheduled for removal and transport to designated areas. Remove gates as whole units. Cut chain link fabric to 25 foot lengths and store in rolls off the ground. Maintain security when required by the COR.

3.1.4 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs including aggregate base as indicated on the Drawings as indicated . Provide neat sawcuts at limits of pavement removal as indicated. Pavement and slabs designated to be recycled and utilized in this project shall be moved, ground and stored as directed by the COR. Pavement and slabs not to be used in this project shall be removed from the Installation at Contractor's expense.

3.1.5 Roofing

Remove existing roof system and associated components in their entirety down to existing roof deck. Remove built-up or single-ply roofing to effect the connections with new flashing or roofing. Remove gravel surfacing from existing roofing felts for a minimum distance of 18 inches back from the cut. Remove gravel without damaging felts. Salvage asphalt roofing materials. Cut existing felts or membrane and insulation along straight lines. Remove roofing system and insulation without damaging the roof deck. Sequence work to minimize building exposure between demolition or and new roof materials installation as approved by the COR.

3.1.5.1 Temporary Roofing

Install temporary roofing and flashing as necessary to maintain a watertight condition throughout the course of the work. Remove temporary

work prior to installation of permanent roof system materials unless approved otherwise by the COR. Make provisions for worker safety during demolition, and installation of new materials as described in paragraphs entitled "Statements" and "Regulatory and Safety Requirements."

3.1.5.2 Reroofing

When removing the existing roofing system from the roof deck, remove only as much roofing as can be recovered by the end of the work day, unless approved otherwise by the COR. Do not attempt to open the roof covering system in threatening weather. Reseal all openings prior to suspension of work the same day.

3.1.6 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain and to facilitate the installation of new work. Where new masonry adjoins existing, the new work shall abut or tie into the existing construction as indicated . Provide square, straight edges and corners where existing masonry adjoins new work and other locations. .

3.1.7 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete. Salvage removed concrete.

3.1.8 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for structural steel, steel joists, girders, angles, plates, columns and shapes. Do not use flame-cutting torches Flame-cutting torches are permitted only when other methods of dismantling are not practical. Transport steel joists and girders as whole units and not dismantled if practical. Transport structural steel shapes to a designated recycling facility , stacked according to size, type of member and length, and stored off the ground, protected from the weather.

3.1.9 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Scrap metal shall become the Contractor's property. Recycle scrap metal as part of demolition and operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.

3.1.10 Carpentry

Salvage for lumber, millwork items, and finished boards, and sort by type and size.

3.1.11 Carpet

Remove existing carpet for reclamation in accordance with manufacturer recommendations and as follows. Remove used carpet in large pieces, roll tightly, and pack neatly in a container. Remove adhesive according to recommendations of the Carpet and Rug Institute (CRI). Adhesive removal solvents shall comply with CRI 104. Recycle removed carpet cushion.

3.1.12 Acoustic Ceiling Tile

Remove, neatly stack, and recycle acoustic ceiling tiles. Recycling may be available with manufacturer. Otherwise, priority shall be given to a local recycling organization.

3.1.13 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces, using on-site materials when available. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

a. Concrete and Masonry: Completely fill holes and depressions, caused by previous physical damage or left as a result of removals in existing masonry walls to remain, with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

b. Where existing partitions have been removed leaving damaged or missing resilient tile flooring, patch to match the existing floor tile.

c. Patch acoustic lay-in ceiling where partitions have been removed. The transition between the different ceiling heights shall be effected by continuing the higher ceiling level over to the first runner on the lower ceiling and closing the vertical opening with a painted sheet metal strip.

3.1.14 Air Conditioning Equipment

Recover all refrigerants prior to removing air conditioning, refrigeration, and other equipment containing refrigerants and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS) unless otherwise indicated by the COR."

3.1.15 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

3.1.16 Locksets on Swinging Doors

Remove all locksets from all swinging doors indicated to be removed and disposed of. Deliver the locksets and related items to a designated location for receipt by the COR after removal as directed.

3.1.17 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Disconnect mechanical equipment and fixtures at fittings. Remove service valves attached to the unit. Salvage each item of equipment and fixtures as a whole unit; listed, indexed, tagged, and stored. Salvage each unit with its normal operating auxiliary equipment. Transport salvaged equipment and fixtures, including motors and machines, to a designated storage area as directed by the COR. Do not remove equipment until approved. Transport mechanical equipment and fixtures to recycling service for disassembly and recycling of parts.

3.1.17.1 Preparation for Storage

Remove water, dirt, dust, and foreign matter from units; tanks, piping and fixtures shall be drained; interiors, if previously used to store flammable, explosive, or other dangerous liquids, shall be steam cleaned. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit. Change lubricating systems with the proper oil or grease.

3.1.17.2 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage as directed by the COR. Store salvaged piping according to size and type. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Box prefabricated supports, hangers, plates, valves, and specialty items according to size and type. Wrap sprinkler heads individually in plastic bags before boxing. Classify piping not designated for salvage, or not reusable as scrap metal and remove from the site.

3.1.17.3 Ducts
t

Classify removed duct work as scrap metal and remove from the site.

3.1.17.4 Fixtures, Motors and Machines

Remove and salvage fixtures, motors and machines associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations. Salvage, box and store auxiliary units and accessories with the main motor and machines. Tag salvaged items for identification, storage, and protection from damage. Classify broken, damaged, or otherwise unserviceable units and not caused to be broken, damaged, or otherwise unserviceable as debris to be disposed of by the Contractor.

3.1.18 Electrical Equipment and Fixtures

Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect primary, secondary, control, communication, and signal circuits at the

point of attachment to their distribution system.

3.1.18.1 Fixtures

Remove and salvage electrical fixtures. Salvage unprotected glassware from the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification, and protected from breakage.

3.1.18.2 Electrical Devices

Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. Box and tag these items for identification according to type and size.

3.1.18.3 Wiring Ducts or Troughs

Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway and store separately.

3.1.18.4 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

3.1.19 Elevators and Hoists

Remove elevators, hoists, and similar conveying equipment and salvage as whole units, to the most practical extent. Remove and prepare items for salvage without damage to any of the various parts. Salvage and store rails for structural steel with the equipment as an integral part of the unit.

3.1.20 Items With Unique/Regulated Disposal Requirements

Remove and dispose of items with unique or regulated disposal requirements in the manner dictated by law or in the most environmentally responsible manner.

3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition or work in areas occupied by structures to be demolished or deconstructed until all demolition and in the area has been completed and debris removed. Fill holes, open basements and other hazardous openings.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and

not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition and , and materials and equipment to be removed, is vested in the Contractor upon approval by the COR of the Contractor's demolition, and removal procedures, and authorization by the COR to begin demolition and . The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.3.2 Reuse of Materials and Equipment

Remove and store materials and equipment listed in the Demolition Plan to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.3.3 Salvaged Materials and Equipment

Remove materials and equipment that are listed in the Demolition Plan and specified to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site as directed by the COR.

a. Salvage items and material to the maximum extent possible.

b. Store all materials salvaged for the Contractor as approved by the COR and remove from Government property before completion of the contract. On site sales of salvaged material is prohibited.

c. Remove salvaged items to remain the property of the Government in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage must be repaired or replaced to match existing items. Properly identify the contents of containers. Deliver the items reserved as property of the Government to the areas designated.

d. Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990, and turn in to the NASA as directed by the COR.

3.3.4 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be turned over to the COR or removed from Government property and disposed of in accordance with 40 CFR 82as directed. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

3.3.4.1 Special Instructions

No more than one type of ODS is permitted in each container. A warning/ hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

a. Activity name and unit identification code

b. Activity point of contact and phone number

c. Type of ODS and pounds of ODS contained

d. Date of placement in container

3.3.4.2 Fire Suppression Containers

Deactivate fire suppression system cylinders and canisters with electrical charges or initiators prior to shipment. Also, safety caps must be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

3.3.5 Transportation Guidance

Ship all ODS containers in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

3.3.6 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material in the disposal area located off site.

3.4 CLEANUP

Remove debris and rubbish from basement and similar excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified off the center in the Waste Management Plan.

3.5.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted.

3.5.3 Removal to Spoil Areas on Government Property

Transport noncombustible materials removed from demolition and structures to designated spoil areas on Government property when directed by the COR.

3.5.4 Removal from Government Property

Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

3.6 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

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SECTION 02 61 13

EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for excavation, handling, and temporary storage of contaminated material.

1.2 MEASUREMENT AND PAYMENT

1.2.1 Measurement

Measurement for excavation and onsite transportation shall be based on the actual number of cubic yards of contaminated material in-place prior to excavation. Determination of the volume of contaminated material excavated shall be based on cross-sectional volume determination reflecting the differential between the original elevations of the top of the contaminated material and the final elevations after removal of the contaminated material. Measurement for backfilling of excavated areas shall be based on in-place cubic yards of compacted fill. Measurement for construction of stockpile areas shall be based on the number of square yards of stockpile liner constructed.

1.2.2 Payment

1.2.2.1 Excavation and Transportation

Compensation for excavation and onsite transportation of contaminated material will be paid as a unit cost. This unit cost shall include any other items incidental to excavation and handling not defined as having a specific unit cost.

1.2.2.2 Backfilling

Compensation for backfill soil, transportation of backfill, backfill soil conditioning, backfilling, compaction, and geotechnical testing will be paid as a single unit cost.

1.2.2.3 Stockpiling

Compensation for construction of stockpile areas will be paid for as a unit cost. This unit cost shall include all aspects of grading, preparation, handling, placement, maintenance, removal, treatment, and disposal of stockpile cover materials and liner materials and all other items incidental to construction of stockpiles.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol

or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM D1556	Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D2167	Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2487	Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D5434	Field Logging of Subsurface Explorations of Soil and Rock
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 302	Designation, Reportable Quantities, and Notification

1.4 DESCRIPTION OF WORK

Submit a Work Plan as specified below.Notify the COR within 48 hours, and before excavation, if contaminated material is discovered that has not been previously identified or if other discrepancies between data provided and actual field conditions are discovered. Ground water is approximately 4 to 9 feet below pre-excavation ground surface.

1.4.1 Scheduling

Notify the COR 7 calendar days prior to the start of excavation of contaminated material. The COR will beresponsible for contacting regulatory agencies in accordance with the applicable reporting requirements as well as coordinating with the ARC Environmental Management Division.

1.4.2 Work Plan

Submit a Work Plan within 30 calendar days after notice to proceed. No work at the site, with the exception of site inspections and surveys, shall be performed until the Work Plan is approved. Allow 30 calendar days in the schedule for the Government's review. No adjustment for time or money will be made if resubmittals of the Work Plan are required due to deficiencies in the plan. At a minimum, the Work Plan shall include:

a. Schedule of activities.

b. Method of excavation and equipment to be used.

c. Shoring or side-wall slopes proposed.

d. Dewatering plan.

e. Storage methods and locations for liquid and solid contaminated material.

f. Borrow sources and haul routes.

g. Decontamination procedures.

h. Spill contingency plan.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Work Plan

SD-06 Test Reports

Backfill
Confirmation Sampling and Analysis
Sampling of Stored Material; Material Not used for onsite backfill to be tested to determine proper disposal.

1.6 REGULATORY REQUIREMENTS

1.6.1 Permits and Licenses

Obtain required federal, state, and local permits for excavation and storage of contaminated material. Permits shall be obtained at no additional cost to the Government.

PART 2 PRODUCTS

2.1 SPILL RESPONSE MATERIALS

Provide appropriate spill response materials including, but not limited to the following: containers, adsorbents, shovels, and personal protective equipment. Spill response materials shall be available at all times when contaminated materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of materials and contaminants being handled.

2.2 BACKFILL

Backfill shall be classified in accordance with ASTM D2487 as GW, GP, GM, GC, SW, SP, SM, SC, ML, MH, CL, or CH and shall be free from roots and other organic matter, trash, debris, snow, ice or frozen materials. Backfill material shall be tested for the parameters listed below at a frequency of once per 500 cubic yards. A minimum of one set of classification tests shall be performed per borrow source.

PART 3 EXECUTION

3.1 EXISTING STRUCTURES AND UTILITIES

No excavation shall be performed until site utilities have been field located. Take the necessary precautions to ensure no damage occurs to existing structures and utilities. Damage to existing structures and utilities resulting from the Contractor's operations shall be repaired at no additional cost to the Government. Utilities encountered that were not previously shown or otherwise located shall not be disturbed without approval from the COR.

3.2 CLEARING

Clearing shall be performed to the limits shown on the drawings in accordance with Section 31 11 00 CLEARING AND GRUBBING.

3.3 CONTAMINATED MATERIAL REMOVAL

3.3.1 Excavation

Areas shall be excavated to the depth and extent shown on the drawings unless directed by the COR. Excavation shall be performed in a manner that will limit spills and the potential for contaminated material to be mixed with uncontaminated material. An excavation log describing visible signs of contamination encountered shall be maintained for each area of excavation. Excavation logs shall be prepared in accordance with ASTM D5434.

3.4 CONFIRMATION SAMPLING AND ANALYSIS

The COR shall be present to inspect the removal of contaminated material from each site. After all material suspected of being contaminated has been removed, the excavation shall be examined for evidence of contamination.

3.5 CONTAMINATED MATERIAL STORAGE

Material shall be placed in temporary storage immediately after excavation. The following paragraphs describe acceptable methods of material storage. Storage units shall be in good condition and constructed of materials that are compatible with the material or liquid to be stored. If multiple storage units are required, each unit shall be clearly labeled with an identification number and a written log shall be kept to track the source of contaminated material in each temporary storage unit.

3.5.1 Stockpiles

Stockpiles shall be constructed to isolate stored contaminated material from the environment. The maximum stockpile size shall be 200 cubic yards. Stockpiles shall be constructed to include:

a. A chemically resistant geomembrane liner free of holes and other damage. Non-reinforced geomembrane liners shall have a minimum thickness of 20 mils. Scrim reinforced geomembrane liners shall have a minimum weight of 40 lbs/1000 square feet. The ground surface on which the geomembrane is to be placed shall be free of rocks greater than 0.5 inches in diameter and any other object which could damage the membrane.
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b. Geomembrane cover free of holes or other damage to prevent precipitation from entering the stockpile. Non-reinforced geomembrane covers shall have a minimum thickness of 10 mils. Scrim reinforced geomembrane covers shall have a minimum weight of 26 lbs/1000 square feet. The cover material shall be extended over the berms and anchored or ballasted to prevent it from being removed or damaged by wind.

c. Berms surrounding the stockpile, a minimum of 12 inches in height. Vehicle access points shall also be bermed.

d. The liner system shall be sloped to allow collection of leachate. Storage and removal of liquid which collects in the stockpile, in accordance with paragraph Liquid Storage.

3.5.2 Liquid Storage

Liquid collected from excavations and stockpiles shall be temporarily stored in 55 gallon barrels or other appropriate storage, such as a Baker Tank, depending on the volume of liquid generated. Liquid storage containers shall be water-tight and shall be located as shown on the drawings .

3.6 SAMPLING

3.6.1 Sampling of Stored Material

Samples of stored material shall be collected at a frequency of once per 100 cubic yards. Samples shall be tested for the following:

Chemical Parameter	Action Level
PCB and Metals and/or other suspected contaminants	TO BE DETERMINED IN FIELD by Environmental Management Division

Stored material with contaminant levels that exceed the action levels shall be treated offsite. Analyses for contaminated material to be taken to an offsite treatment facility shall conform to local, state, and federal criteria as well as to the requirements of the treatment facility. Documentation of all analyses performed shall be furnished to the COR. Additional sampling and analyses to the extent required by the approved offsite treatment, storage or disposal (TSD) facility shall be the responsibility of the Contractor and shall be subject to approval by the COR.

3.6.2 Sampling Liquid

Liquid collected from excavations shall be sampled at a frequency of once for every 55 gallon drum collected gal of liquid collected. Samples shall be tested for the following:

Chemical Parameter	Action Level
PCB and Metals and/or other suspected contaminants	TO BE DETERMINED IN FIELD by Environmental Management Division

Liquid with contaminant levels that exceed action levels shall be treated offsite. Analyses for contaminated liquid to be taken to an offsite

treatment facility shall conform to local, state, and federal criteria as well as to the requirements of the treatment facility. Documentation of all analyses performed shall be furnished to the COR. Additional sampling and analysis to the extent required by the approved offsite treatment, storage or disposal (TSD) facility receiving the material shall be the responsibility of the Contractor and shall be subject to approval by the COR.

3.7 SPILLS

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), pollutant, contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), notify the COR immediately. If the spill exceeds the reporting threshold, follow the pre-established procedures as described in the Base Wide Contingency Plan for immediate reporting and containment. Immediate containment actions shall be taken to minimize the effect of any spill or leak. Cleanup shall be in accordance with applicable federal, state, and local regulations. As directed by the COR, additional sampling and testing shall be performed to verify spills have been cleaned up. Spill cleanup and testing shall be done at no additional cost to the Government.

3.8 BACKFILLING

3.8.1 Confirmation Test Results

Excavations shall be backfilled immediately after all contaminated materials have been removed and confirmation test results have been approved. Backfill shall be placed and compacted to the lines and grades shown on the drawings.

3.8.2 Compaction

Engineered fill consisting of imported material or on-site soil which is not expansive should be compacted to at least 90 percent relative compaction as determined by ASTM D1557 at a moisture content slightly above laboratory optimum. Engineered fill consisting of native expansive soils should be compacted to 87 to 92 percent relative compaction at a moisture content of at least 3 percent laboratory optimum. The upper six inches of soil beneath asphalt concrete pavements should be compacted to at least 92 percent relative compaction. Fill material should be spread and compacted in lifts not exceeding 8 inches in pre-compacted thickness. Density tests shall be performed at a frequency of once per 2,500 square feet per lift. A minimum of 4 density tests shall be performed on each lift of backfill placed. Field in-place dry density shall be determined in accordance with ASTM D1556, ASTM D2167, or ASTM D6938. If ASTM D6938 is used, a minimum of one in ten tests shall be checked using ASTM D1556 or ASTM D2167. Test results from ASTM D1556 or ASTM D2167 shall govern if there is a discrepancy with the ASTM D6938 test results.

3.9 DISPOSAL REQUIREMENTS

Offsite disposal of contaminated material shall be in accordance with Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS.

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SECTION 02 81 00

TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for transportation and disposal of hazardous material.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

IATA DGR	Dangerous Goods Regulations

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program
40 CFR 300	National Oil and Hazardous Substances

	Pollution Contingency Plan
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
49 CFR 107	Hazardous Materials Program Procedures
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 178	Specifications for Packagings

1.3 DEFINITIONS

1.3.1 Hazardous Material

A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated pursuant to the Hazardous Materials Transportation Act, 49 U.S.C. Appendix Section 1801 et seq. The term includes materials designated as hazardous materials under the provisions of 49 CFR 172, Sections .101 and .102 and materials which meet the defining criteria for hazard classes and divisions in 49 CFR 173. EPA designated hazardous wastes are also hazardous materials.

1.3.2 Hazardous Waste

A waste which meets criteria established in RCRA or specified by the EPA in 40 CFR 261 or which has been designated as hazardous by a RCRA authorized state program.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Onsite Hazardous Waste Management
Notices of Non-Compliance and Notices of Violation
Packaging Notifications

SD-06 Test Reports

Recordkeeping
Spill Response

Exception Report

SD-07 Certificates

Certification
Security Plan
Transportation and Disposal Coordinator
Training
EPA Offsite Policy
Certificates of Disposal
Shipping Documents and Packagings Certification
Waste Minimization

1.5 QUALITY ASSURANCE

1.5.1 Transportation and Disposal Coordinator

Designate, by position and title, one person to act as the Transportation and Disposal Coordinator (TDC) for this contract. The TDC shall serve as the single point of contact for all environmental regulatory matters and shall have overall responsibility for total environmental compliance at the site including, but not limited to, accurate identification and classification of hazardous waste and hazardous materials; determination of proper shipping names; identification of marking, labeling, packaging and placarding requirements; completion of waste profiles, hazardous waste manifests, asbestos waste shipment records, PCB manifests, bill of ladings, exception and discrepancy reports; and all other environmental documentation. The TDC shall have, at a minimum, one year of specialized experience in the management and transportation of hazardous waste and have been Department of Transportation certified under 49 CFR 172, Subpart H.

1.5.2 Training

The Contractor's hazardous materials employees shall be trained, tested, and certified to safely and effectively carry out their assigned duties in accordance with Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES. The Contractor's employees transporting hazardous materials or preparing hazardous materials for transportation, including samples, shall be trained, tested, and certified in accordance with 49 CFR 172, Subpart H, including security awareness and any applicable security plans. Where shipment of hazardous materials by air may be occurring, such as for sample shipments, the Contractor's hazardous material employees shall also be trained on IATA DGR. Contractor employees making determinations that shipments do not constitute DOT regulated hazardous materials shall also be trained, tested, and certified in accordance with 49 CFR 172, Subpart H.

1.5.3 Certification

The Contractor and/or subcontractors transporting hazardous materials shall possess a current certificate of registration issued by the Research and Special Programs Administration (RSPA), U.S. Department of Transportation, when required by 49 CFR 107, Subpart G. Submit copies of the certificates or written statements certifying exemption from these requirements.

1.5.4 Laws and Regulations Requirements

Work shall meet or exceed the minimum requirements established by Federal, State, and local laws and regulations which are applicable. These

requirements are amended frequently and compliance with amendments is required as they become effective. In the event that compliance exceeds the scope of work or conflicts with specific requirements of the contract, notify the COR immediately.

PART 2 PRODUCTS

2.1 MATERIALS

Provide all the materials required for the packaging, labeling, marking, placarding and transportation of hazardous wastes and hazardous materials in conformance with Department of Transportation standards or IATA DGR. Details in this specification shall not be construed as establishing the limits of the Contractor's responsibility.

2.1.1 Packagings

Provide bulk and non-bulk containers for packaging hazardous materials/wastes consistent with the authorizations referenced in the Hazardous Materials Table in 49 CFR 172, Section .101, Column 8. Bulk and non-bulk packaging shall meet the corresponding specifications in 49 CFR 173 referenced in the Hazardous Materials Table, 49 CFR 172, Section .101. Each packaging shall conform to the general packaging requirements of Subpart B of 49 CFR 173, to the requirements of 49 CFR 178 at the specified packing group performance level, to the requirements of special provisions of column 7 of the Hazardous Materials Table in 49 CFR 172, Section .101, and shall be compatible with the material to be packaged as required by 40 CFR 262. Also provide other packaging related materials such as materials used to cushion or fill voids in overpacked containers, etc. Sorbent materials shall not be capable of reacting dangerously with, being decomposed by, or being ignited by the hazardous materials being packaged. Additionally, sorbents used to treat free liquids to be disposed of in landfills shall be non-biodegradable as specified in 40 CFR 264, Section .314. In addition, packaging notifications will be provided to the Government in accordance with 49 CFR 172, Section .178.2(c) regarding type and dimensions of closures, including gaskets, needed to satisfy performance test requirements.

2.1.2 Markings

Provide markings for each hazardous material/waste package, freight container, and transport vehicle consistent with the requirements of 49 CFR 172, Subpart D and 40 CFR 262, Section .32 (for hazardous waste) 40 CFR 761, Section .45 (for PCBs) 40 CFR 61, Section .149(d) (for asbestos). Markings shall be capable of withstanding, without deterioration or substantial color change, a 180 day exposure to conditions reasonably expected to be encountered during container storage and transportation.

2.1.3 Labeling

Provide primary and subsidiary labels for hazardous materials/wastes consistent with the requirements in the Hazardous Materials Table in 49 CFR 172, Section .101, Column 6. Labels shall meet design specifications required by 49 CFR 172, Subpart E including size, shape, color, printing, and symbol requirements. Labels shall be durable and weather resistant and capable of withstanding, without deterioration or substantial color change, a 180 day exposure to conditions reasonably expected to be encountered during container storage and transportation.

2.1.4 Placards

For each offsite shipment of hazardous material/waste, provide primary and subsidiary placards consistent with the requirements of 49 CFR 172, Subpart F. Placards shall be provided for each side and each end of bulk packaging, freight containers, transport vehicles, and rail cars requiring such placarding. Placards may be plastic, metal, or other material capable of withstanding, without deterioration, a 30 day exposure to open weather conditions and shall meet design requirements specified in 49 CFR 172, Subpart F.

2.1.5 Spill Response Materials

Provide spill response materials including, but not limited to, containers, adsorbent, shovels, and personal protective equipment. Spill response materials shall be available at all times in which hazardous materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of material being handled.

2.2 EQUIPMENT AND TOOLS

Provide miscellaneous equipment and tools necessary to handle hazardous materials and hazardous wastes in a safe and environmentally sound manner.

PART 3 EXECUTION

3.1 ONSITE HAZARDOUS WASTE MANAGEMENT

These paragraphs apply to Government owned waste only. Contractors are prohibited by 10 U.S.C. 2692 from storing Contractor owned waste onsite for any length of time. The Contractor is responsible for ensuring compliance with all Federal, State, and local hazardous waste laws and regulations and shall verify those requirements when preparing reports, waste shipment records, hazardous waste manifests, or other documents. Identify hazardous wastes using criteria set forth in 40 CFR 261 or all applicable State and local laws, regulations, and ordinances. When accumulating hazardous waste onsite, comply with generator requirements in 40 CFR 262 and 22 CCR 66262 to 265 and Santa Clara CUPA Regulations. Onsite accumulation times shall be restricted to applicable time frames referenced in 40 CFR 262, Section .34 and 22 CCR 66262.34. Accumulation start dates shall commence when waste is first generated (i.e. containerized or otherwise collected for discard). Only use containers in good condition and compatible with the waste to be stored. Ensure containers are closed except when adding or removing waste, and immediately mark all hazardous waste containers with the words "hazardous waste" and other information required by 40 CFR 262, Section .32 and 22 CCR 66262.32 as soon as the waste is containerized. An additional marking shall be placed on containers of "unknowns" designating the date sampled, and the suspected hazard. Inspect containers for signs of deterioration and for responding to any spills or leaks. Inspect all hazardous waste areas weekly and provide written documentation of the inspection. Include date and time of inspection, name of individual conducting the inspection, problems noted, and corrective actions taken on the inspection logs.

3.1.1 Hazardous Waste Classification

Identify, in consultation with the waste generator, all waste codes applicable to each hazardous waste stream based on requirements in

40 CFR 261 or any applicable State or local law or regulation. Also identify all applicable treatment standards in 40 CFR 268 and State land disposal restrictions and make a determination as to whether or not the waste meets or exceeds the standards. Waste profiles, analyses, classification and treatment standards information shall be submitted to COR for review and approval.

3.1.2 Management Plan

Prepare a plan detailing the manner in which hazardous wastes will be managed and describing the types and volumes of hazardous wastes anticipated to be managed as well as the management practices to be utilized. The plan shall identify the method to be used to ensure accurate piece counts and/or weights of shipments; shall identify waste minimization methods; shall propose facilities to be utilized for treatment, storage, and/or disposal; shall identify areas onsite where hazardous wastes are to be handled; and shall identify whether transfer facilities are to be utilized; and if so, how the wastes will be tracked to ultimate disposal. Submit the plan prior to start of work. Written documentation of weekly hazardous waste inspections shall be submitted on a quarterly basis.

3.2 OFFSITE HAZARDOUS WASTE MANAGEMENT

Use RCRA Subtitle C permitted facilities which meet the requirements of 40 CFR 264 or facilities operating under interim status which meet the requirements of 40 CFR 265. Offsite treatment, storage, and/or disposal facilities with significant RCRA violations or compliance problems (such as facilities known to be releasing hazardous constituents into ground water, surface water, soil, or air) shall not be used. Submit Notices of Non-Compliance and Notices of Violation by a Federal, State, or local regulatory agency issued to the Contractor in relation to any work performed under this contract. Immediately provide copies of such notices to the COR. Also furnish all relevant documents regarding the incident and any information requested by the COR, and coordinate its response to the notice with the COR or the designated representative prior to submission to the notifying authority. Also furnish a copy to the COR of all documents submitted to the regulatory authority, including the final reply to the notice, and all other materials, until the matter is resolved.

3.2.1 Treatment, Storage, and/or Disposal Facility and Transporter

Provide the COR with EPA ID numbers, names, locations, and telephone numbers of TSD facilities and transporters. This information shall be contained in the Hazardous Waste Management Plan and shall be approved by the COR prior to waste disposal.

3.2.2 Status of the Facility

Facilities receiving hazardous waste shall be permitted in accordance with 40 CFR 270 or operating under interim status in accordance with 40 CFR 265 requirements, or permitted by a State authorized by the Environmental Protection Agency to administer the RCRA permit program. Additionally, prior to using a TSD Facility, contact the EPA Regional Offsite Coordinator specified in 40 CFR 300, Section .440, to determine the facility's status, and document all information necessary to satisfy the requirements of the EPA Offsite policy and submit this information to the COR.

3.2.3 Shipping Documents and Packagings Certification

Prior to shipment of any hazardous material offsite and a minimum of 7 days prior to anticipated pickup, the Contractor's TDC shall provide for review written certification to the COR that hazardous materials have been properly packaged, labeled, and marked in accordance with Department of Transportation and EPA requirements. The original Designated Facility to Generator copy of the hazardous waste manifest shall be furnished by the designated disposal facility not later than 35 days after acceptance of the shipment. The Contractor's TDC shall also provide written certification regarding waste minimization efforts documenting that efforts have been taken to reduce the volume and toxicity of waste to the degree economically practicable and that the method of treatment, storage, or disposal selected minimizes threats to human health and the environment.

3.2.4 Transportation

Prior to conducting hazardous materials activities, the Contractor responsible for pre-transportation activities shall either certify to the Government that a HM Security Plan is in place which meets the requirements of 49 CFR 172, Subpart I or in the event that the types or amounts of hazardous materials are excluded from the security planning requirements, a written statement to that effect detailing the basis for the exception. Use manifests for transporting hazardous wastes as required by 40 CFR 263 or any applicable State or local law or regulation. Transportation shall comply with all requirements in the Department of Transportation referenced regulations in the 49 CFR series. Prepare hazardous waste manifests for each shipment of hazardous waste shipped offsite. Manifests shall be completed using instructions in 40 CFR 262, Subpart B and any applicable State or local law or regulation. Submit manifests and waste profiles to COR for review and approval. Prepare land disposal restriction notifications as required by 40 CFR 268 or any applicable State or local law or regulation for each shipment of hazardous waste. Submit notifications with the manifest to the Environmental Management Division for review and approval.

3.2.5 Treatment and Disposal of Hazardous Wastes

The hazardous waste shall be transported to an approved hazardous waste treatment, storage, or disposal facility within 90 days of the accumulation start date on each DOT container. Ship hazardous wastes only to facilities which are properly permitted to accept the hazardous waste or operating under interim status. Ensure wastes are treated to meet land disposal treatment standards in 40 CFR 268 prior to land disposal. Propose TSD facilities via submission of the Hazardous Waste Management Plan, subject to the approval of the COR. Submit Certificates of Disposal documenting the ultimate disposal, destruction or placement of polychlorinated biphenyls (PCBs) within 180 days of initial shipment. Receipt of these certificates will be required for final payment.

3.3 RADIOACTIVE MATERIALS MANAGEMENT

In consultation with the COR generator, evaluate, prior to shipment of any material offsite, whether the material is regulated as a hazardous waste in addition to being regulated as a radioactive material; this shall be done for the purpose of determining proper shipping descriptions, marking requirements, etc., as described below.

3.3.1 Identification of Proper Shipping Names

Use 49 CFR 172, Section .101 to identify proper shipping names for each hazardous material (including hazardous wastes) to be shipped offsite. Submit proper shipping names to the COR in the form of draft shipping documents for review and approval at least 3 days before shipment for review and approval.

3.3.2 Packaging, Labeling, and Marking

Package, label, and mark hazardous materials/wastes using the specified materials and in accordance with the referenced authorizations. Mark each container of hazardous waste of 110 gallons or less with the following:

"HAZARDOUS WASTE - Federal Law Prohibits Improper Disposal.
If found, contact the nearest police or public safety authority or the U.S. Environmental Protection Agency.
Generator's name _____
Manifest Document Number _____".

3.3.3 Shipping Documents

Ensure that each shipment of hazardous material sent offsite is accompanied by properly completed shipping documents. This includes shipments of samples that may potentially meet the definition of a Department of Transportation regulated hazardous material.

3.3.3.1 PCB Waste Shipment Documents

Prepare hazardous waste manifests for each shipment of PCB waste shipped offsite. Complete manifests using instructions in 40 CFR 761, Sections .207 and .208 and all other applicable requirements. Submit documents to Environmental Management Division for review and approval.

3.3.3.2 Asbestos Waste Shipment Documents

Prepare waste shipment records, as required by 40 CFR 61, for shipments of asbestos. Submit waste shipment records to the Environmental Management Division for review and approval. Waste shipment records shall be signed by the Contractor.

3.3.3.3 Other Hazardous Material Shipment Documents

Prepare a bill of lading for each shipment of hazardous material which is not accompanied by a hazardous waste manifest or asbestos waste shipment record which fulfills the shipping paper requirements. The bill of lading shall satisfy the requirements of 49 CFR 172, Subpart C, and any applicable State or local law or regulation, and shall be submitted to the Environmental Management Division for review and approval. For laboratory samples and treatability study samples, prepare bills of lading and other documentation as necessary to satisfy conditions of the sample exclusions in 40 CFR 261, Section .4(d) and (e) and any applicable State or local law or regulation. Bill of ladings requiring shipper's certifications shall be signed by the Government.

3.4 OBTAINING EPA ID NUMBERS

Complete EPA Form 8700-12, Notification of Hazardous Waste Activity, and submit to the COR for review and approval. Allow a minimum of 30 days for

processing the application and assigning the EPA ID number. Shipment shall be made not earlier than one week after receipt of the EPA ID number.

3.5 SPECIAL REQUIREMENTS FOR ASBESTOS WASTES

If work involves asbestos containing wastes, manage these wastes in accordance with Section 3.3.3.2 of this specification.

3.6 WASTE MINIMIZATION

Minimize the generation of hazardous waste to the maximum extent practicable and take all necessary precautions to avoid mixing clean and contaminated wastes. Identify and evaluate recycling and reclamation options as alternatives to land disposal. Requirements of 40 CFR 266 shall apply to: hazardous wastes recycled in a manner constituting disposal; hazardous waste burned for energy recovery; lead-acid battery recycling; and hazardous wastes with economically recoverable precious metals. Submit written certification that waste minimization efforts have been undertaken to reduce the volume and toxicity of waste to the degree economically practicable and that the method of treatment, storage, or disposal selected minimizes threats to human health and the environment.

3.7 RECORDKEEPING

The Contractor is responsible for maintaining adequate records to support information provided to the COR regarding exception reports, annual reports, and biennial reports; maintaining asbestos waste shipment records for a minimum of 3 years from the date of shipment or any longer period required by any applicable law or regulation or any other provision of this contract; and maintaining bill of ladings for a minimum of 375 days from the date of shipment or any longer period required by any applicable law or regulation or any other provision of this contract. Submit information necessary to file State annual or EPA biennial reports for all hazardous waste transported, treated, stored, or disposed of under this contract. Do not forward these data directly to the regulatory agency but to the COR at the specified time. The submittal shall contain all the information necessary for filing of the formal reports in the form and format required by the governing Federal or State regulatory agency. A cover letter shall accompany the data to include the contract number, Contractor name, and project location. In the event that a manifest copy documenting receipt of hazardous waste at the treatment storage and disposal facility is not received within 35 days of shipment initiation, or that a manifest copy documenting receipt of PCB waste at the designated facility is not received within 35 days of shipment initiation, prepare and submit an exception report to the COR within 37 days of shipment initiation.

3.8 SPILL RESPONSE

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), or pollutant or contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), notify the COR immediately. Any direction from the COR concerning a spill or release shall not be considered a change under the contract. If the spill exceeds a reporting threshold, follow the pre-established procedures for immediate reporting to the COR. Comply with all applicable requirements of Federal, State, or local laws or regulations regarding any spill incident.

3.9 EMERGENCY CONTACTS

The Contractor is responsible for complying with the emergency contact provisions in 49 CFR 172, Section .604. Whenever the Contractor ships hazardous materials, provide a 24 hr emergency response contact and phone number of a person knowledgeable about the hazardous materials being shipped and who has comprehensive emergency response and incident mitigation information for that material, or has immediate access to a person who possesses such knowledge and information. The phone shall be monitored on a 24 hour basis at all times when the hazardous materials are in transportation, including during storage incidental to transportation. Ensure that information regarding this emergency contact and phone number are placed on all hazardous material shipping documents. Designate an emergency coordinator and post the following information at areas in which hazardous wastes are managed:

a. The name of the emergency coordinator.

b. Phone number through which the emergency coordinator can be contacted on a 24 hour basis.

c. The telephone number of the local fire department.

d. The location of fire extinguishers and spill control materials.

Attachment A SAMPLE OFF-SITE POLICY CERTIFICATION MEMO	
Project/Contract #:	
Waste Stream:	
Primary TSD Facility, EPA ID #	
Alter. TSD Facility, EPA ID # and	
EPA Region	Contact
I	(617) 918-1752
II	(212) 637-4130
III	(214) 814-5267
IV	(404) 562-8591
V	(312) 353-8207
VI	(214) 665-2282
VII	(913) 551-7154
VIII	(303) 312-6419
IX	(415) 972-3304
X	(206) 553-2859
EPA representative contacted:	
EPA representative phone number:	
Date contacted:	
Comment:	
The above EPA representative was contacted on _____. As of that date the above sites were considered acceptable in accordance with the Off-Site	
Date:	Signature:
Phone number:	

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ASBESTOS HAZARD CONTROL ACTIVITIES

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for removal, encapsulation, enclosureencasement, or repair of friable and non-friable asbestos-containing material (ACM) which is encountered during the demolition, alteration, renovation, or maintenance of structures, substrates, equipment or portions thereof that contain asbestos; transportation, disposal, storage, containment of; and housekeeping activities on the site at which these activities are performed This specification is used in conjunction with Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS.

1.2 PAYMENT PROCEDURES

Submit copies of weight bills and delivery tickets for payment to the COR during the progress of the work. Furnish scale tickets for each load of ACM weighed and certified. These tickets shall include tare weight; identification mark for each vehicle weighed; and date, time and location of loading and unloading. Tickets shall be furnished at the point and time individual trucks arrive at the worksite. A master log of all vehicle loading shall be furnished for each day of loading operations. Before the final statement is allowed, file with the COR certified weigh bills and/or certified tickets and manifests of all ACM actually disposed by the Contractor for this contract.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA)

AIHA Z9.2	Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems

ASTM INTERNATIONAL (ASTM)

ASTM D 4397	Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 1368	Visual Inspection of Asbestos Abatement

Projects

BAY AREA AIR QUALITY MANAGEMENT DISTRICT (BAAQMD)

Regulation #11	Rule #2

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-7	Compressed Air for Human Respiration; 6th Edition

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z87.1	Occupational and Educational Personal Eye and Face Protection Devices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701	Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 94-113	NIOSH Manual of Analytical Methods

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 340/1-90/018	Asbestos/NESHAP Regulated Asbestos Containing Materials Guidance

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134	Respiratory Protection
29 CFR 1910.141	Sanitation
29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)
29 CFR 1926.1101	Asbestos
29 CFR 1926.32	Safety and Health Regulations for Construction - Definition
40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 763, Subpart E	Asbestos Emergency Response Act (AHERA)
42 CFR 84	Approval of Respiratory Protective Devices
49 CFR 107	Hazardous Materials Program Procedures
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response

	Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packagings

UNDERWRITERS LABORATORIES (UL)

UL 586	Standard for High-Efficiency Particulate, Air Filter Units

1.4 DEFINITIONS

1.4.1 Amended Water

Water containing a wetting agent or surfactant with a surface tension of at least 29 dynes per square centimeter.

1.4.2 Asbestos-Containing Material (ACM)

Any materials containing more than one percent asbestos.

1.4.3 Asbestos-Containing Construction Material (ACCM)

Any material containing more than one tenth of one percent asbestos.

1.4.4 Authorized Person

Any person authorized by the Contractor and required by work duties to be present in the regulated areas.

1.4.5 BAAQMD - Bay Area Air Quality Management District

Local EPA Region 9 enforcement.

1.4.6 Building Inspector

Individual who inspects buildings for asbestos and has EPA Model Accreditation Plan (MAP) "Building Inspector" training; accreditation required by 40 CFR 763, Subpart E, Appendix C, has EPA/State certification/license as a "Building Inspector".

1.4.7 CAC - Certified Asbestos Consultant

Certification administered by California's Division of Occupational Safety and Health for contracting asbestos consultant work.

1.4.8 Class I Asbestos Work

Activities defined by OSHA involving the removal of thermal system insulation (TSI) and surfacing ACM.

1.4.9 Class II Asbestos Work

Activities defined by OSHA involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos - containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastic. Certain "incidental" roofing materials such as mastic, flashing and cements when they are still intact are excluded from Class II asbestos work. Removal of

small amounts of these materials which would fit into a glovebag may be classified as a Class III job.

1.4.10 Class III Asbestos Work

Activities defined by OSHA that involve repair and maintenance operations, where ACM, including TSI and surfacing ACM, is likely to be disturbed. Operations may include drilling, abrading, cutting a hole, cable pulling, crawling through tunnels or attics and spaces above the ceiling, where asbestos is actively disturbed or asbestos-containing debris is actively disturbed.

1.4.11 Class IV Asbestos Work

Maintenance and custodial construction activities during which employees contact but do not disturb ACM and activities to clean-up dust, waste and debris resulting from Class I, II, and III activities. This may include dusting surfaces where ACM waste and debris and accompanying dust exists and cleaning up loose ACM debris from TSI or surfacing ACM following construction

1.4.12 Clean Room

An uncontaminated room having facilities for the storage of employees' street clothing and uncontaminated materials and equipment.

1.4.13 Competent Person

In addition to the definition in 29 CFR 1926.32(f), a person who is capable of identifying existing asbestos hazards as defined in 29 CFR 1926.1101, selecting the appropriate control strategy, has the authority to take prompt corrective measures to eliminate them and has EPA Model Accreditation Plan (MAP) "Contractor/Supervisor" training; has EPA/State certification/license as a "Contractor/Supervisor".

1.4.14 Contractor/Supervisor

Individual who supervises asbestos abatement work and has EPA Model Accreditation Plan "Contractor/Supervisor" training; has EPA/State certification as a "Contractor/Supervisor".

1.4.15 Critical Barrier

One or more layers of plastic sealed over all openings into a regulated area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in a regulated area from migrating to an adjacent area.

1.4.16 Decontamination Area

An enclosed area adjacent and connected to the regulated area and consisting of an equipment room, shower area, and clean room, which is used for the decontamination of workers, materials, and equipment that are contaminated with asbestos.

1.4.17 Demolition

The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.

1.4.18 Disposal Bag

A 6 mil thick, leak-tight plastic bag, pre-labeled in accordance with 29 CFR 1926.1101, used for transporting asbestos waste from containment to disposal site.

1.4.19 Disturbance

Activities that disrupt the matrix of ACM, crumble or pulverize ACM, or generate visible debris from ACM. Disturbance includes cutting away small amounts of ACM, no greater than the amount which can be contained in 1 standard sized glovebag or waste bag, not larger than 60 inches in length and width in order to access a building component.

1.4.20 Equipment Room or Area

An area adjacent to the regulated area used for the decontamination of employees and their equipment.

1.4.21 Friable ACM

A term defined in 40 CFR 61, Subpart M and EPA 340/1-90/018 meaning any material which contains more than 1 percent asbestos, as determined using the method specified in 40 CFR 763, Polarized Light Microscopy (PLM), that when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

1.4.22 Glovebag

Not more than a 60 by 60 inch impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which material and tools may be handled.

1.4.23 High-Efficiency Particulate Air (HEPA) Filter

A filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers in diameter.

1.4.24 Intact

ACM which has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix. Removal of "intact" asphaltic, resinous, cementitious products does not render the ACM non-intact simply by being separated into smaller pieces.

1.4.25 Model Accreditation Plan (MAP)

USEPA training accreditation requirements for persons who work with asbestos as specified in 40 CFR 763.

1.4.26 NASA Consultant (NC)

Code QH Safety, Health and Medical Services personnel who have obtained a California Asbestos Consultant (CAC) credentials.

1.4.27 Negative Initial Exposure Assessment

A demonstration by the Contractor to show that employee exposure during an operation is expected to be consistently below the OSHA Permissible

Exposure Limits (PELs).

1.4.28 NESHAP

National Emission Standards for Hazardous Air Pollutants. The USEPA NESHAP regulation for asbestos is at 40 CFR 61, Subpart M.

1.4.29 Nonfriable ACM

A NESHAP term defined in 40 CFR 61, Subpart M and EPA 340/1-90/018 meaning any material containing more than 1 percent asbestos that, when dry, cannot be crumbled, pulverized or reduced to powder by hand pressure.

1.4.30 Nonfriable ACM (Category I)

A NESHAP term defined in 40 CFR 61, Subpart E and EPA 340/1-90/018 meaning asbestos-containing packings, gaskets, resilient floor covering, and asphalt roofing products containing more than 1 percent asbestos.

1.4.31 Nonfriable ACM (Category II)

A NESHAP term defined in 40 CFR 61, Subpart E and EPA 340/1-90/018 meaning any material, excluding Category I nonfriable ACM, containing more than 1 percent asbestos.

1.4.32 Permissible Exposure Limits (PELs)

1.4.32.1 PEL-Time Weighted Average(TWA)

Concentration of asbestos not in excess of 0.1 fibers per cubic centimeter of air (f/cc) as an 8 hour time weighted average (TWA).

1.4.32.2 PEL-Excursion Limit

An airborne concentration of asbestos not in excess of 1.0 f/cc of air as averaged over a sampling period of 30 minutes.

1.4.33 Regulated Area

An OSHA term defined in 29 CFR 1926.1101 meaning an area established by the Contractor to demarcate areas where Class I, II, and III asbestos work is conducted; also any adjoining area where debris and waste from such asbestos work accumulate; and an area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed, the permissible exposure limit.

1.4.34 Removal

All operations where ACM is taken out or stripped from structures or substrates, and includes demolition operations.

1.4.35 Repair

Overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates, including encapsulation or other repair of ACM attached to structures or substrates.

1.4.36 Surfacing ACM

Asbestos-containing material which contains more than 1% asbestos and is sprayed-on, troweled-on, or otherwise applied to surfaces, such as acoustical plaster on ceilings and fireproofing materials on structural members, or other materials on surfaces for acoustical, fireproofing, or other purposes.

1.4.37 Thermal System Insulation (TSI) ACM

ACM which contains more than 1% asbestos and is applied to pipes, fittings, boilers, breeching, tanks, ducts, or other interior structural components to prevent heat loss or gain or water condensation.

1.4.38 Transite

A generic name for asbestos cement wallboard and pipe.

1.4.39 Worker

Individual (not designated as the Competent Person or a supervisor) who performs asbestos work and has completed asbestos worker training required by 29 CFR 1926.1101, to include EPA Model Accreditation Plan (MAP) "Worker" training; accreditation if required by the OSHA Class of work to be performed or by the state where the work is to be performed.

1.5 SYSTEM DESCRIPTION

This section covers all operations in which asbestos-containing materials (ACM) are encountered. These procedures and equipment are required to protect workers and building occupants from airborne asbestos fibers and ACM dust and debris. Activities may include OSHA Class I, Class II , Class III, or Class IV work operations. This section also includes containment, storage, transportation and disposal of the generated ACM wastes. Submit Detailed Drawings containing descriptions, and site layout to include worksite containment area(s), local exhaust systems locations, decontamination units and load-out units, other temporary waste storage facility, access tunnels, location of temporary utilities (electrical, water, sewer) and boundaries of each regulated area. Complete Table 1 and submit to NC.

1.5.1 Abatement Work Tasks

The specific ACM to be abated is identified on the detailed plans and project drawings.

1.5.2 Unexpected Discovery of Asbestos

For any previously untested building components suspected to contain asbestos and located in areas impacted by the work, notify the COR (CO) who will have the option of ordering the NC to collect bulk samples to be obtained and delivered to a laboratory accredited under the National Institute of Standards and Technology (NIST) "National Voluntary Laboratory Accreditation Program (NVLAP)" and analyzed by PLM. If the asbestos content is less than 10 percent, as determined by a method other than point counting, the asbestos content shall be verified by point counting or stated to be greater than 1% asbestos content. Any additional components identified as ACM that have been approved by the CO for removal shall be removed and will be paid for by an equitable adjustment to the contract

price under the CONTRACT CLAUSE titled "changes". Bulk sampling shall be conducted by personnel who have successfully completed the EPA Model Accreditation Plan (MAP) "Building Inspector" training course and is State certified and licensed as a CAC or CSST by the California Department of Occupational Safety and Health.

1.6 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detailed Drawings of regulated area layout including emergency egress, decontamination chamber and negative air machines

SD-03 Product Data

MSDS of all chemicals brought onsite
Respiratory Protection Program - 29 CFR Part 1910.B4
Procedures for Evacuation of injured workers
Training Program
DOSH Licenses for Asbestos Work
Contractor Insurance Policy for Asbestos Work
Notification for Proposed Asbestos Work to CAL/OSHA and BAAQMD

SD-06 Test Reports

SD-07 Certificates

Local Exhaust and Vacuum System On-site Dispersed Oil Particle (DOP) Testing
Training
Medical Surveillance Requirements
Fit testing

1.7 QUALITY ASSURANCE

In addition to detailed requirements of this specification, work performed under this contract shall comply with applicable federal, state, and local laws, ordinances, criteria, rules and regulations regarding handling, storing, transporting, and disposing of asbestos waste materials. Matters of interpretation of standards shall be submitted to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements shall apply. The following state and local laws, rules and regulations regarding demolition, removal, encapsulation, construction alteration, repair, maintenance, renovation, spill/emergency cleanup, housekeeping, handling, storing, transporting and disposing of asbestos material apply.

1.7.1 Written Qualifications and Organization Report

Submit a written qualifications and organization report providing evidence of qualifications of the Contractor, Contractor's Project Supervisor, Designated Competent Person, supervisors and workers; all subcontractors to be used including disposal transportation and disposal facility firms, subcontractor supervisors, subcontractor workers; and any others assigned to perform asbestos abatement and support activities. Include in the

report an organization chart showing the Contractor's staff organization chain of command and reporting relationship with all subcontractors.

1.7.2 Specific Requirements

Designate in writing, personnel meeting the following qualifications:

a. Asbestos Abatement Contractor: Certified/licensed by applicable state agencies to perform asbestos-related activities.

b. Designated Competent Person: Qualified in accordance with 29 CFR 1926.32 and 29 CFR 1926.1101, has EPA MAP "Contractor/Supervisor" training accreditation, has EPA/State certification/license as a "Contractor/Supervisor" and is experienced in the administration and supervision of asbestos abatement projects, including exposure assessment and monitoring, work practices, abatement methods, protective measures for personnel, setting up and inspecting asbestos abatement work areas, evaluating the integrity of containment barriers, placement and operation of local exhaust systems, ACM generated waste containment and disposal procedures, decontamination units installation and maintenance requirements, site safety and health requirements, notification of other employees onsite, etc. The Designated Competent Person shall be responsible for compliance with applicable federal, state and local requirements, the Contractor's Accident Prevention Plan (APP) and Asbestos Hazard Abatement Plan (AHAP). Submit the "Contractor/Supervisor" course completion certificate and the most recent certificate for required refresher training. The Designated Competent Person shall be onsite at all times during the conduct of this project.

d. Asbestos Abatement Workers: Meet the requirements contained in 29 CFR 1926.1101, 40 CFR 61, Subpart M, and other applicable federal, state and local requirements. Training documentation is required for each employee who will perform OSHA Class I, Class II, Class III, or Class IV asbestos abatement operations. Training course completion certificates (initial and most recent update refresher).

e. Independent Testing Laboratory: Identify the independent testing laboratory selected to perform the sample analyses and report the Phase Contrast Microscopy results of employee's personal air sampling. The testing laboratory shall be completely independent from the Contractor as recognized by federal, state or local regulations. All laboratories shall also participate in a national sample testing scheme such as the Proficiency Analytical Testing Program (PAT), or the Asbestos Registry sponsored by the American Industrial Hygiene Association (AIHA).

f. Disposal Facility, Transporter: Written evidence that the landfill to be used is approved for asbestos disposal by the local regulatory agencies. Copies of signed agreements between the Contractor (including subcontractors and transporters) and the asbestos waste disposal facility to accept and dispose of all asbestos containing waste shall be provided. The Contractor and transporters shall meet the DOT requirements of 49 CFR 171, 49 CFR 172, and 49 CFR 173 as well as registration requirements of 49 CFR 107 and other applicable state or local requirements. The disposal facility shall meet the requirements of 40 CFR 61, Sections .154 or .155, as required in 40 CFR 61 150(b), and other applicable state or local requirements.

1.7.3 Federal, State or Local Citations on Previous Projects

The Contractor and all subcontractors shall submit a statement, signed by an officer of the company, containing a record of any citations issued by Federal, State or local regulatory agencies relating to asbestos activities (including projects, dates, and resolutions); a list of penalties incurred through non-compliance with asbestos project specifications, including liquidated damages, overruns in scheduled time limitations and resolutions; and situations in which an asbestos-related contract has been terminated (including projects, dates, and reasons for terminations). If there are none, a negative declaration signed by an officer of the company shall be provided.

1.7.4 Preconstruction Conference

The Contractor and the Contractor's Designated Competent Person, Project Supervisor, shall meet with the COR (CO) and NASA Health and Safety Office's asbestos representative (NC) prior to beginning asbestos work at a safety preconstruction conference to discuss the details of the Contractor's submitted APP to include the AHAP and AHAs appendices. Deficiencies in the APP will be discussed. Onsite work shall not begin until the APP has been accepted.

1.8 SAFETY

Prepare a written comprehensive site-specific Accident Prevention Plan (APP) at least 30 days prior to the preconstruction conference. The APP shall incorporate an Asbestos Hazard Abatement Plan (AHAP), and Activity Hazard Analyses (AHAs) as separate appendices into one site-specific document. The APP shall take into consideration all the individual asbestos abatement work tasks identified in Table 1.

1.8.1 Asbestos Hazard Abatement Plan Appendix

The AHAP shall include, but not be limited to, the following:

a. The personal protective equipment to be used;

b. The location and description of regulated areas including clean and dirty areas,access tunnels, and decontamination unit (clean room, shower room, equipment room, storage areas such as load-out unit);

c. Initial exposure assessment in accordance with 29 CFR 1926.1101;

d. Level of supervision;

e. Method of notification of other employers at the worksite;

f. Abatement method to include containment and control procedures;

g. Interface of trades;

h. Sequencing of asbestos related work;

i. Storage and disposal procedures and plan;

j. Type of wetting agent and asbestos encapsulant;

k. Location of local exhaust equipment;

l. Air monitoring methods (personal, environmental and clearance);

m. Bulk sampling and analytical methods (if required);

n. A detailed description of the method to be employed in order to control the spread of ACM wastes and airborne fiber;

o. Fire and medical emergency response procedures;

p. The security procedures to be used for all regulated areas.

1.8.2 Local Exhaust System

Local exhaust units shall conform to AIHA Z9.2 and 29 CFR 1926.1101. Filters on local exhaust system equipment shall conform to AIHA Z9.2 and UL 586. Filter shall be UL labeled and DOP tested prior to use. Submit pressure differential recordings and Manufacturer's certifications showing compliance with AIHA Z9.2 for:

a. Vacuums

b. Water filtration equipment

c. Ventilation equipment

d. Other equipment required to contain airborne asbestos fibers

1.9 SECURITY

1.9.1 Licenses, Permits and Notifications

Obtain necessary licenses, permits and notifications in conjunction with the project's asbestos abatement, transportation and disposal actions and timely notification furnished of such actions as required by federal, state, regional, and local authorities. The Contractor shall notify the Regional Office of the USEPA, BAAQMD, state OSHA program and CALOSHA in writing, at least 10 days prior to the commencement of work, in accordance with 40 CFR 61, Subpart M, and state and local requirements to include the mandatory "Notification of Demolition and Renovation Record" form and other required notification documents. Local fire department shall be notified 3 days before fireproofing material is removed from a building and the notice shall specify whether or not the material contains asbestos. The Contractor is responsible for the associated fees/costs for licenses, permits, and notifications.

1.9.2 Regulated Areas

All Class I, II, and III asbestos work shall be conducted within regulated areas. The regulated area shall be demarcated to minimize the number of persons within the area and to protect persons outside the area from exposure to airborne asbestos. Control access to regulated areas, ensure that only authorized personnel enter, and verify that Contractor required medical surveillance, training and respiratory protection program requirements are met prior to allowing entrance.

1.9.3 Warning Signs and Tape

Warning signs and tape printed bilingually in English and Spanish shall be provided at the regulated boundaries and entrances to regulated areas. Signs shall be located to allow personnel to read the signs and take the necessary protective steps required before entering the area. Warning signs displaying the following legend in the lower panel shall be posted:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA

1.9.4 Warning Labels

Warning labels shall be affixed to all asbestos disposal containers, asbestos materials, scrap, waste debris, and other products contaminated with asbestos. Containers with preprinted warning labels conforming to requirements are acceptable.

1.10 MEDICAL SURVEILLANCE REQUIREMENTS

Medical surveillance requirements shall conform to 29 CFR 1926.1101. Asbestos workers shall be enrolled in a medical surveillance program that meets 29 CFR 1926.1101 (m) requirements and other pertinent state or local requirements. This requirement shall have been satisfied within the last 12 months. Submit required medical certification and the Physician's written opinion.

1.10.1 Respiratory Protection Program

The Contractor shall establish in writing, and implement a respiratory protection program in accordance with 29 CFR 1926.1101 and 29 CFR 1910.134. The Contractor shall establish minimum respiratory protection requirements based on measured or anticipated levels of airborne asbestos fiber concentrations.

1.10.2 Respiratory Fit Testing

The Contractor shall conduct a qualitative or quantitative fit test conforming to Appendix A of 29 CFR 1910.134 for each worker required to wear a respirator, and any authorized visitors who enter a regulated area where respirators are required to be worn. A respirator fit test shall be performed prior to initially wearing a respirator and every 12 months thereafter. If physical changes develop that will affect the fit, a new fit test shall be performed. Functional fit checks shall be performed each time a respirator is put on and in accordance with the manufacturer's recommendation.

1.10.3 Respirator Selection and Use Requirements

Provide respirators, and ensure that they are used as required by 29 CFR 1926.1101 and 1910.134. Respirators shall be approved by the National Institute for Occupational Safety and Health NIOSH, under the provisions of 42 CFR 84, for use in environments containing airborne asbestos fibers. For air-purifying respirators, the particulate filter shall be high-efficiency particulate air (HEPA)/(N-,R-,P-100). The initial respirator selection and the decisions regarding the upgrading or

downgrading of respirator type shall be made by the NASA NC based on the measured or anticipated airborne asbestos fiber concentrations to be encountered.

1.10.4 Personal Protective Equipment

Provide workers with personal protective clothing and equipment and ensure that it is worn properly. The Designated Competent Person shall select and approve all the required personal protective clothing and equipment.

1.10.5 Whole Body Protection

Personnel exposed to or having the potential to be exposed to airborne concentrations of asbestos that exceed the PELs, or for all OSHA Classes of work for which a required negative exposure assessment is not produced, shall be provided with whole body protection and such protection shall be worn properly. Disposable whole body protection shall be disposed of as asbestos contaminated waste upon exiting from the regulated area. Reusable whole body protection worn shall be either disposed of as asbestos contaminated waste upon exiting from the regulated area or be properly laundered in accordance with 29 CFR 1926.1101. The Contractor's Designated Competent Person, in consultation with the Designated IH, has the authority to take immediate action to upgrade or downgrade whole body protection when there is an immediate danger to the health and safety of the wearer.

1.10.5.1 Gloves

Gloves shall be provided to protect the hands where there is the potential for hand injuries (i.e., scrapes, punctures, cuts, etc.).

1.10.5.2 Foot Coverings

Cloth socks shall be provided and worn next to the skin. Footwear, as required by OSHA and EM 385-1-1, that is appropriate for safety and health hazards in the area shall be worn. Reusable footwear removed from the regulated area shall be thoroughly decontaminated or disposed of as ACM waste.

1.10.5.3 Head Covering

Hood type disposable head covering shall be provided. In addition, protective head gear (hard hats) shall be provided as required. Hard hats shall only be removed from the regulated area after being thoroughly decontaminated.

1.10.5.4 Protective Eye Wear

Eye protection shall be provided, when operations present a potential eye injury hazard, and shall meet the requirements of ANSI/ISEA Z87.1.

1.11 HYGIENE

Establish a decontamination area for the decontamination of employees, material and equipment. Ensure that employees enter and exit the regulated area through the decontamination area.

1.11.1 3-Stage Decontamination Area

A temporary negative pressure decontamination unit that is adjacent and

attached in a leak-tight manner to the regulated area shall be provided during all Class I work. The decontamination unit shall have an equipment room and a clean room separated by a shower that complies with 29 CFR 1910.141, unless the Contractor can demonstrate that such facilities are not feasible. Equipment and surfaces of containers filled with ACM shall be cleaned prior to removing them from the equipment room or area. Provide a minimum of 1 shower. Wastewater shall be collected and filtered to remove asbestos contamination. Filters and residue shall be disposed of as asbestos contaminated material. Filtered water shall be discharged to the sanitary sewer system. Wastewater filters shall be installed in series with the first stage pore size of 20 microns and the second stage pore size of 5 microns. The floor of the decontamination unit's clean room shall be kept dry and clean at all times. Proper housekeeping and hygiene requirements shall be maintained. Soap and towels shall be provided for showering, washing and drying. Any cloth towels provided shall be disposed of as ACM waste or shall be laundered in accordance with 29 CFR 1926.1101.

1.11.2 Load-Out Unit

A temporary load-out unit that is adjacent and connected to the regulated area shall be provided. The load-out unit shall be attached in a leak-tight manner to each regulated area.

1.11.3 Single Stage Decontamination Area

A decontamination area (equipment room/area) shall be provided for Class I work involving less than 25 feet or 10 square feet of TSI or surfacing ACM, and for Class II and Class III asbestos work operations where exposures exceed the PELs or where there is no negative exposure assessment. The equipment room or area shall be adjacent to the regulated area for the decontamination of employees, material, and their equipment which could be contaminated with asbestos. The area shall be covered by an impermeable drop cloth on the floor or horizontal working surface. The area must be of sufficient size to accommodate cleaning of equipment and removing personal protective equipment without spreading contamination beyond the area.

1.11.4 Decontamination Area Exit Procedures

Ensure that the following procedures are followed:

a. Before leaving the regulated area, remove all gross contamination and debris from work clothing using a HEPA vacuum.

b. Employees shall remove their protective clothing in the equipment room and deposit the clothing in labeled impermeable bags or containers.

c. Employees shall not remove their respirators until showering.

d. Employees shall shower prior to entering the clean room. If a shower has not been located between the equipment room and the clean room or the work is performed outdoors, ensure that employees engaged in Class I asbestos jobs: a) Remove asbestos contamination from their work suits in the equipment room or decontamination area using a HEPA vacuum before proceeding to a shower that is not adjacent to the work area; or b) Remove their contaminated work suits in the equipment room, without cleaning worksuits, and proceed to a shower that is not adjacent to the work area.

1.11.5 Smoking

Smoking, if allowed by the Contractor, shall only be permitted in designated areas approved by the CO.

1.12 TRAINING PROGRAM

Establish and submit a training program as specified by EPA MAP, training requirements at 40 CFR 763, the State of California, OSHA requirements at 29 CFR 1926.1101 (k)(9). Contractor employees shall complete the required training for the type of work they are to perform and such training shall be documented and provided to the CO.

a. Class I and II operations 32 hours Asbestos Worker Training
b. Class II specific training to trades such as roofing, A/C piping, flooring, removal 8 hour Asbestos Worker Training
c. Class III operations 16 hour O & M Training
d. Class IV operations 2 hour Awareness Training

Prior to commencement of work the Contractor's Competent Person shall instruct each worker about:

a. The hazards and health effects of the specific types of ACM to be abated; and

b. The content and requirements of the Contractor's APP to include the AHAP and AHAs and site-specific safety and health precautions.

PART 2 PRODUCTS

2.1 ENCAPSULANTS

Encapsulants shall conform to USEPA requirements, shall contain no toxic or hazardous substances and no solvent. Submit certificates stating that encapsulants meet the applicable specified performance requirements.

2.2 ENCASEMENT PRODUCTS

Encasement shall consist of primary cellular polymer coat, polymer finish coat, and any other finish coat as approved by the CO.

2.3 RECYCLABLE MATERIALS

Recyclable materials shall conform to EPA requirements in accordance with Section 01 62 35 RECYCLED/RECOVERED MATERIALS.

2.4 EXPENDABLE SUPPLIES

2.4.1 Glovebag

Glovebags shall be provided as described in 29 CFR 1926.1101 and SET-UP DETAIL SHEET 10. The glovebag assembly shall be 6 mil thick plastic, prefabricated and seamless at the bottom with preprinted OSHA warning label. Inside of building glovebag work will require secondary containment. Secondary containment will need air circulation prior to removal.

2.4.2 Duct Tape

Industrial grade duct tape of appropriate widths suitable for bonding sheet plastic and disposal container.

2.4.3 Disposal Containers

Leak-tight (defined as solids, liquids, or dust that cannot escape or spill out) disposal containers shall be provided for ACM wastes as required by 29 CFR 1926.1101 and DETAIL SHEETS 9A, 9B, 9C and 14. Disposal containers can be in the form of:

a. Disposal Bags

b. Fiberboard Drums

c. Cardboard Boxes

2.4.4 Sheet Plastic

Sheet plastic shall be polyethylene of 6 mil minimum thickness and shall be provided in the largest sheet size necessary to minimize seams . Film shall be clear frosted and conform to ASTM D 4397, except as specified below:

2.4.4.1 Flame Resistant

Where a potential for fire exists, flame-resistant sheets shall be provided. Film shall be frosted and shall conform to the requirements of NFPA 701.

2.4.4.2 Reinforced

Reinforced sheets shall be provided where high skin strength is required, such as where it constitutes the only barrier between the regulated area and the outdoor environment. The sheet stock shall consist of translucent, nylon-reinforced or woven-polyethylene thread laminated between 2 layers of polyethylene film. Film shall meet flame resistant standards of NFPA 701.

2.4.5 Mastic Removing Solvent

Mastic removing solvent shall be nonflammable and shall not contain methylene chloride, glycol ether, or halogenated hydrocarbons. Solvents used onsite shall have a flash point greater than 140 degrees F.

2.4.6 Leak-tight Wrapping

Two layers of 6 mil minimum thick polyethylene sheet stock shall be used for the containment of removed asbestos-containing components or materials such as reactor vessels, large tanks, boilers, insulated pipe segments and other materials too large to be placed in disposal bags as described in DETAIL SHEET 9B. Upon placement of the ACM component or material, each layer shall be individually leak-tight sealed with duct tape.

2.4.7 Viewing Inspection Window

Per BAAQMD, a minimum of 1 clear, 1/8 inch thick, acrylic sheet, 18 by 24 inches, shall be installed as a viewing inspection window at eye level on a wall in each containment enclosure. The windows shall be sealed leak-tight

with industrial grade duct tape.

2.4.8 Wetting Agents

Removal encapsulant (a penetrating encapsulant) shall be provided when conducting removal abatement activities that require a longer removal time or are subject to rapid evaporation of amended water. The removal encapsulant shall be capable of wetting the ACM and retarding fiber release during disturbance of the ACM greater than or equal to that provided by amended water. Performance requirements for penetrating encapsulants are specified in paragraph ENCAPSULANTS above.

2.4.9 Strippable Coating

Strippable coating in aerosol cans shall be used to adhere to surfaces and to be removed cleanly by stripping, at the completion of work.

2.5 EQUIPMENT

2.5.1 Tools

Vacuums shall be equipped with HEPA filters, of sufficient capacity and necessary capture velocity at the nozzle or nozzle attachment to efficiently collect, transport and retain the ACM waste material. All HEPA vacuums shall be DOP tested onsite prior to abatement work. Power tools shall not be used to remove ACM unless the tool is equipped with effective, integral HEPA filtered exhaust ventilation capture and collection system. Reusable tools shall be thoroughly decontaminated prior to being removed from regulated areas.

2.5.2 Rental Equipment

If rental equipment is to be used, written notification shall be provided to the rental agency, concerning the intended use of the equipment, the possibility of asbestos contamination of the equipment and the steps that will be taken to decontaminate such equipment.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Asbestos abatement work tasks shall be performed as shown on the detailed plans and drawings, as summarized in Table 1. Use the engineering controls and work practices required in 29 CFR 1926.1101(g) in all operations regardless of the levels of exposure. Personnel shall wear and utilize protective clothing and equipment. Do not permit eating, smoking, drinking, chewing or applying cosmetics in the regulated area. Personnel of other trades, shall not be exposed at any time to airborne concentrations of asbestos unless all the administrative and personal protective provisions of the Contractor's APP are complied with. Power to the regulated area shall be locked-out and tagged in accordance with 29 CFR 1910.147, and temporary electrical service with ground fault circuit interrupters shall be provided as needed. Temporary electrical service shall be disconnected when necessary for wet removal. Stop abatement work in the regulated area immediately when the airborne total fiber concentration: (1) equals or exceeds 0.01 f/cc, or the pre-abatement concentration, whichever is greater, outside the regulated area; or (2) equals or exceeds 1.0 f/cc inside the regulated area. Correct the condition to the satisfaction of the NC, including visual inspection and

air sampling. Work shall resume only upon notification by the NC. Corrective actions shall be documented.

3.2 PROTECTION OF ADJACENT WORK OR AREAS TO REMAIN

Perform asbestos abatement without damage to or contamination of adjacent work or area. Where such work or area is damaged or contaminated, it shall be restored to its original condition or decontaminated at no expense to the Government. When spills occur, work shall stop in all effected areas immediately and the spill shall be cleaned. When satisfactory visual inspection and air sampling analysis results are obtained and have been evaluated by the NASA NC, work shall proceed.

3.3 OBJECTS

3.3.1 Removal of Mobile Objects

The Government will remove Furniture and equipment from the area of work before work begins unless contract states otherwise. Furnishings shall be precleaned using HEPA filtered vacuum followed by wet wiping. These objects shall be removed to an area or site designated by the CO. Carpets, draperies, and other items which may not be suitable for onsite wet cleaning methods shall be properly cleaned in accordance with 29 CFR 1926.1101.

3.3.2 Stationary Objects

Stationary objects, furniture, and equipment that needs to remain in place shall be precleaned using HEPA vacuum followed by adequate wet wiping. Stationary objects and furnishings shall be covered with 2 layers of polyethylene and edges sealed with duct tape.

3.4 BUILDING VENTILATION SYSTEM AND CRITICAL BARRIERS

Building ventilation system supply and return air ducts in a regulated area shall be shut down, if feasible, and isolated. The isolation of airtight seals shall consist of air-tight rigid covers for building ventilation supply and exhaust grills where the ventilation system is required to remain in service during abatement apply 2 layers of polyethylene. Edges to wall, ceiling and floor surfaces shall be sealed with industrial grade duct tape.

3.5 PRECLEANING

Surfaces shall be cleaned by HEPA vacuum and adequately wet wiped prior to establishment of containment.

3.6 METHODS OF COMPLIANCE

3.6.1 Mandated Practices

The specific abatement techniques and items identified shall be detailed in the Contractor's AHAP. Use the following engineering controls and work practices in all operations, regardless of the levels of exposure:

a. DOP tested vacuum cleaners equipped with HEPA filters.

b. Wet methods or wetting agents except where it can be demonstrated that the use of wet methods is unfeasible due to the creation of electrical

hazards, equipment malfunction, and in roofing that may be unsafe for wet methods.

c. Prompt clean-up and disposal.

d. Inspection and repair of polyethylene.

e. Cleaning of equipment and surfaces of containers prior to removing them from the equipment room or area.

3.6.2 Control Methods

Use the following control methods:

a. DOP tested local exhaust ventilation equipped with HEPA filter;

b. Enclosure or isolation of processes producing asbestos dust;

c. Where the feasible engineering and work practice controls are not sufficient to reduce employee exposure to or below the PELs, use them to reduce employee exposure to the lowest levels attainable and shall supplement them by the use of respiratory protection.

3.6.3 Unacceptable Practices

The following work practices shall not be used:

a. High-speed abrasive disc saws that are not equipped with point of cut ventilator or enclosures with HEPA filtered exhaust air.

b. Compressed air used to remove asbestos containing materials, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air.

c. Dry sweeping, shoveling, or other dry clean up.

d. Employee rotation as a means of reducing employee exposure to asbestos.

3.6.4 Class I Work Procedures

In addition to requirements of paragraphs Mandated Practices and Control Methods, the following engineering controls and work practices shall be used:

a. A Competent Person shall supervise the installation and operation of the control methods.

b. For jobs involving the removal of more than 25 feet or 10 square feet of TSI or surfacing material, place critical barriers over all openings to the regulated area.

c. HVAC systems shall be isolated in the regulated area by sealing with a double layer of plastic or air-tight rigid covers.

d. Impermeable dropcloths (6 mil or greater thickness) shall be placed on surfaces beneath all removal activity.

e. Where a negative exposure assessment has not been provided or where exposure monitoring shows the PEL was exceeded, the regulated area

shall be ventilated with a HEPA unit and employees must use PPE.

3.6.5 Specific Control Methods for Class I Work

3.6.5.1 Negative Pressure Enclosure (NPE) System

The system shall provide at least 4 air changes per hour inside the containment. The local exhaust unit equipment shall be operated 24 hours per day until the containment is removed. The NPE shall be smoke tested for leaks at the beginning of each shift and be sufficient to maintain a minimum pressure differential of minus 0.02 inch of water column relative to adjacent, unsealed areas. Pressure differential shall be monitored continuously, 24 hours per day, with an automatic manometric recording instrument and Records shall be provided daily on the same day collected to the NC. The NC shall be notified immediately if the pressure differential falls below the prescribed minimum. The building ventilation system shall not be used as the local exhaust system for the regulated area. The NPE shall terminate outdoors unless an alternate arrangement is allowed by the Health and Safety Office representative (NC). All filters used shall be new at the beginning of the project and shall be periodically changed as necessary and disposed of as ACM waste.

3.6.5.2 Glovebag Systems

Glovebags shall be used without modification, smoke-tested for leaks, and completely cover the circumference of pipe or other structures where the work is to be done. Glovebags shall be used only once and shall not be moved. Glovebags shall not be used on surfaces that have temperatures exceeding 150 degrees F. All glovebags located inside a building, should have secondary containment. Prior to disposal, glovebags shall be collapsed using a HEPA vacuum. Before beginning the operation, loose and friable material adjacent to the glovebag operation shall be wrapped and sealed in 2 layers of plastic or otherwise rendered intact. At least 2 persons shall perform glovebag removal. Asbestos regulated work areas shall be established as shown on detailed drawings and plans and Table 1 for glovebag abatement. Designated boundary limits for the asbestos work shall be established with rope or other continuous barriers and all other requirements for asbestos control areas shall be maintained, including area signage and boundary warning tape.

a. Attach HEPA vacuum systems to the bag to prevent collapse during removal of ACM.

b. The negative pressure glove boxes shall be fitted with gloved apertures and a bagging outlet and constructed with rigid sides from metal or other material which can withstand the weight of the ACM and water used during removal. A negative pressure shall be created in the system using a HEPA filtration system. The box shall be smoke tested for leaks prior to each use.

3.6.5.3 Mini-Enclosures

Mini-enclosures may be used if the disturbance or removal can be completely contained by the enclosure. The mini-enclosure shall be inspected for leaks and smoke tested before each use. Air movement shall be directed away from the employee's breathing zone within the mini-enclosure.

3.6.5.4 Wrap and Cut Operation

Prior to cutting pipe, the asbestos-containing insulation shall be wrapped with polyethylene and securely sealed with duct tape to prevent asbestos becoming airborne as a result of the cutting process. The following steps shall be taken: install glovebag, strip back sections to be cut 6 inches from point of cut, and cut pipe into manageable sections.

3.6.6 Class II Work

In addition to the requirements of paragraphs Mandated Practices and Control Methods, the following engineering controls and work practices shall be used:

a. A Competent Person shall supervise the work.

b. For indoor work, critical barriers shall be placed over all openings to the regulated area.

c. Impermeable dropcloths shall be placed on surfaces beneath all removal activity.

3.6.7 Specific Control Methods for Class II Work

3.6.7.1 Vinyl and Asphalt Flooring Materials

Resilient sheeting shall be removed by adequately wet methods. Tiles shall be removed intact (if possible); wetting is not required when tiles are heated and removed intact. Flooring or its backing shall not be sanded. Scraping of residual adhesive and/or backing shall be performed using wet methods. Mechanical chipping is prohibited unless performed in a negative pressure enclosure. Dry sweeping is prohibited. Use vacuums equipped with HEPA filter, disposable dust bag, and metal floor tool (no brush) to clean floors.

3.6.7.2 Roofing Material

Roofing material shall be removed in an intact state. Wet methods shall be used to remove roofing materials that are not intact, or that will be rendered not intact during removal, unless such wet methods are not feasible or will create safety hazards. When removing built-up roofs, with asbestos-containing roofing felts and an aggregate surface, using a power roof cutter, all dust resulting from the cutting operations shall be collected by a HEPA dust collector, or shall be HEPA vacuumed by vacuuming along the cut line. Asbestos-containing roofing material shall not be dropped or thrown to the ground, but shall be lowered to the ground via covered, dust-tight chute, crane, hoist or other method approved by the Health and Safety Office representative (NC). Any ACM that is not intact shall be lowered to the ground as soon as practicable, but not later than the end of the work shift. While the material remains on the roof it shall be kept wet or placed in an impermeable waste bag or wrapped in plastic sheeting. Intact ACM shall be lowered to the ground as soon as practicable, but not later than the end of the work shift. Unwrapped material shall be transferred to a closed receptacle. Critical barriers shall be placed over roof level heating and ventilation air intakes.

3.6.7.3 Cementitious Siding and Shingles or Transite Panels

When removing cementitious asbestos-containing siding, shingles or transite

panels the ACM will be removed substantially intact. Intentionally cutting, abrading or breaking is prohibited. Each panel or shingle shall be sprayed with amended water prior to removal. Nails shall be cut with flat, sharp instruments. Unwrapped or unbagged panels or shingles shall be immediately lowered to the ground via covered dust-tight chute, crane or hoist, or placed in an impervious waste bag or wrapped in plastic sheeting and lowered to the ground no later than the end of the work shift.

3.6.7.4 Gaskets

Gaskets shall be thoroughly wetted with amended water prior to removal and immediately placed in a disposal container. If a gasket is visibly deteriorated and unlikely to be removed intact, removal shall be undertaken within a glovebag. Any scraping to remove residue shall be performed wet.

3.6.8 Specific Control Methods for Class III Work

Class III asbestos work shall be conducted using engineering and work practice controls which minimize the exposure to employees performing the asbestos work. The work shall be performed using wet methods and, to the extent feasible, using local exhaust. Use impermeable drop cloths and shall isolate the operation, using mini-enclosures or glovebag systems, where the disturbance involves drilling, cutting, abrading, sanding, chipping, breaking, or sawing of TSI or surfacing material.

3.6.9 Specific Control Methods for Class IV Work

Class IV jobs shall be conducted using wet methods and HEPA vacuums. Employees cleaning up debris and waste in a regulated area where respirators are required shall wear the selected respirators.

3.6.10 Methods for Asphaltic Wrap

Removal or disturbance of pipeline asphaltic wrap shall be performed using wet methods.

3.6.11 Abatement of Asbestos Contaminated Soil

Asbestos contaminated soil shall be removed from areas to a minimum depth of 2 inches. Soil shall be thoroughly dampened with amended water and then removed by manual shoveling into labeled containers.

3.6.12 Encapsulation of ACM

Prior to applying any encapsulant, the entire surface area shall be inspected for loose, or damaged asbestos material:

a. Penetrating Encapsulation: Before penetrating encapsulation is applied, asbestos removal work in the area shall be complete. Substrate shall be evaluated before application to ensure that the encapsulant will not cause the substrate to fail in any way. Plug samples shall be taken to determine if full penetration has been achieved. If full penetration has not been achieved, surfaces shall be recoated while the matrix is still wet, until full penetration is achieved.

b. Bridging Encapsulation: The surface shall be encapsulated in sections of 1000 square feet or less as recommended by the encapsulant manufacturer. Upon completion of each section, the dry thickness of

the bridging encapsulation shall be measured. Additional bridging encapsulant shall be applied to obtain the desited encapsulant thickness. Additional coats shall blend with the original bridging encapsulant. Bridging encapsulation shall include:

3.6.13 Combined Encapsulation of Acoustical Wall and Ceiling Plaster

The combination penetrating/bridging encapsulation system shall be installed by first applying the penetrating encapsulant and then the bridging encapsulant.

3.7 FINAL CLEANING AND VISUAL INSPECTION

After completion of all asbestos removal work and the gross amounts of asbestos have been removed from every surface, any remaining visible accumulations of asbestos shall be collected. For all classes of indoor asbestos abatement projects a final cleaning shall be performed using HEPA vacuum and wet cleaning of all exposed surfaces and objects in the regulated area. Upon completion of the cleaning, conduct a visual pre-inspection of the cleaned area in preparation for a final inspection before final air clearance monitoring. The Contractor and the NC shall conduct a final visual inspection of the cleaned regulated area in accordance with ASTM E 1368 and document the results on the Final Cleaning and Visual Inspection If the CO rejects the clean regulated area as not meeting final cleaning requirements, reclean as necessary and have a follow-on inspection conducted with the NC. Recleaning and follow-up reinspection shall be at the Contractor's expense.

3.8 LOCKDOWN

Prior to removal of plastic barriers and after final visual inspection, an encapsulant may be required to spray applied to ceiling, walls, floors, and other surfaces in the regulated area.

3.9 EXPOSURE ASSESSMENT AND AIR MONITORING

3.9.1 General Requirements

a. Exposure assessment, air monitoring and analysis of airborne concentration of asbestos fibers shall be performed in accordance with 29 CFR 1926.1101, and the Contractor's air monitoring plan. Results of breathing zone samples shall be posted at the job site and made available to the NC. Submit all documentation regarding initial exposure assessments, negative exposure assessments, and air-monitoring results.

b. Worker Exposure.

1. The Contractor shall collect samples representative of the exposure of each employee who is assigned to work within a regulated area. Breathing zone samples shall be taken for at least 25 percent of the workers in each shift, or a minimum of 2, whichever is greater.

2. Workers shall not be exposed to an airborne fiber concentration in excess of 1.0 f/cc, as averaged over a sampling period of 30 minutes. Should a personal excursion concentration of 1.0 f/cc expressed as a 30-minute sample occur inside a regulated work area, stop work immediately, notify the COR, and implement

additional engineering controls and work practice controls to reduce airborne fiber levels below prescribed limits in the work area. Do not restart work until authorized by the CO.

c. Environmental Exposure (Perimeter Sampling)

1. All environmental air monitoring shall be performed by NASA's Health and Safety Representative, NC.

2. Environmental air monitoring shall be performed using NIOSH 94-113 Method 7400 (PCM) with confirmation of results by OSHA TEM for samples above clearance criterion of .01 f/cc.

3. For environmental and final clearance, air monitoring shall be conducted at a sufficient velocity and duration to establish the limit of detection of the method used at 0.005 f/cc.

4. When confirming asbestos fiber concentrations (asbestos f/cc) from environmental samples, use TEM in accordance with NIOSH 94-113 Method 7402. When such confirmation is conducted, it shall be from the same sample filter used for the NIOSH 94-113 Method 7400 PCM analysis. All confirmation of asbestos fiber concentrations, using NIOSH 94-113 Method 7402, shall be at the Contractor's expense.

5. At the discretion of the COR, fiber concentration may exceed 0.1 f/cc but shall not exceed 1.0 f/cc expressed as an 8-hour TWA. Should an environmental concentration of 1.0 f/cc expressed as an 8-hour TWA occur inside a regulated work area, stop work immediately, notify the COR, and implement additional engineering controls and work practice controls to reduce airborne fiber levels below prescribed limits in the work area. Work shall not restart until authorized by the CO.

3.9.2 Negative Exposure Assessment

Provide a negative exposure assessment, if using, for reduced PPE for the specific asbestos job which will be performed within 10 days of the initiation of the project and conform to the following criteria:

a. Objective Data: Objective data demonstrating that the product or material containing asbestos minerals or the activity involving such product or material cannot release airborne fibers in concentrations exceeding the PEL-TWA and PEL-Excursion Limit under those work conditions having the greatest potential for releasing asbestos.

b. Prior Asbestos Jobs: Where the Contractor has monitored prior asbestos jobs for the PEL and the PEL-Excursion Limit within 12 months of the current job, the monitoring and analysis were performed in compliance with asbestos standard in effect; the data were obtained during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the Contractor's current operations; the operations were conducted by employees whose training and experience are no more extensive than that of employees performing the current job; and these data show that under the conditions prevailing and which will prevail in the current workplace, there is a high degree of certainty that the monitoring covered exposure from employee exposures will not exceed the PEL-TWA and

PEL-Excursion Limit.

c. Initial Exposure Monitoring: The results of initial exposure monitoring of the current job, made from breathing zone air samples that are representative of the 8-hour PEL-TWA and 30-minute short-term exposures of each employee. The monitoring covered exposure from operations which are most likely during the performance of the entire asbestos job to result in exposures over the PELs.

3.9.3 Environmental Air Monitoring During Abatement

Environmental air monitoring shall be conducted by the NC at locations and frequencies that will accurately characterize any evolving airborne asbestos fiber concentrations in NASA occupied buildings. The assessment shall demonstrate that the product or material containing asbestos minerals, or the abatement involving such product or material, cannot release airborne asbestos fibers in concentrations exceeding 0.01 f/cc as a TWA under those work conditions having the greatest potential for releasing asbestos. The monitoring shall be at least once per shift at locations including, but not limited to, outside entrances to a regulated area; close to glovebag operations; critical barriers outside of the perimeter of a regulated area; inside clean room; and at the exhaust discharge point of local exhaust system ducted to the outside of a containment, but inside the building. If the sampling outside regulated area shows airborne fiber levels have exceeded background or 0.01 f/cc, whichever is greater, work shall be stopped immediately, and the COR notified. The condition causing the increase shall be corrected. Work shall not restart until authorized by the CO.

3.9.4 Final Clearance Air Monitoring

NASA's Health and Safety respresentative, NC will conduct final clearance air monitoring using aggressive air sampling techniques as defined in 40 CFR 763, Subpart E, Appendix A, Unit III, TEM Method B.7(d-f) for all indoor asbestos abatement projects. Clearance air monitoring is not required for outside work or for soil cleanups.

3.9.4.1 Final Clearance Requirements, NIOSH PCM Method

For PCM sampling and analysis using NIOSH 94-113 Method 7400, the fiber concentration inside the abated regulated area, for each airborne sample, shall be less than 0.01 f/cc. The abatement inside the regulated area is considered complete when every PCM final clearance sample is below the clearance limit. If any sample result is greater than 0.01 total f/cc, the asbestos fiber concentration (asbestos f/cc) shall be confirmed from that same filter using NIOSH 94-113 Method 7402 (TEM) at Contractor's expense. If any confirmation sample result is greater than 0.01 asbestos f/cc, abatement is incomplete and cleaning shall be repeated. Upon completion of any required recleaning, resampling with results to meet the above clearance criteria shall be done.

3.9.4.2 Final Clearance Requirements, EPA TEM Method

For EPA TEM sampling and analysis, using the EPA Method specified in 40 CFR 763, abatement inside the regulated area is considered complete when the arithmetic mean asbestos concentration of the 5 inside samples is less than or equal to 70 structures per square millimeter (70 S/mm). When the arithmetic mean is greater than 70 S/mm, the 3 blank samples shall be analyzed. If the 3 blank samples are greater than 70 S/mm, resampling

shall be done. If less than 70 S/mm, the 5 outside samples shall be analyzed and a Z-test analysis performed. When the Z-test results are less than 1.65, the decontamination shall be considered complete. If the Z-test results are more than 1.65, the abatement is incomplete and cleaning shall be repeated. Upon completion of any required recleaning, resampling with results to meet the above clearance criteria shall be done.

3.9.4.3 Air Clearance Failure

If clearance sampling results fail to meet the final clearance requirements, pay all costs associated with the required recleaning, resampling, and analysis, until final clearance requirements are met.

3.9.5 Air-Monitoring Results and Documentation

Air sample fiber counting shall be completed and results provided within 24 hours (breathing zone samples), and 48 hours (environmental/clearance monitoring) after completion of a sampling period. The CO shall be notified immediately of any airborne levels of asbestos fibers in excess of established requirements. Written sampling results shall be provided within 5 working days of the date of collection. The written results shall be signed by testing laboratory analyst, testing laboratory principal and the Contractor's Designated IH or CO's IH. The air sampling results shall be documented on a Contractor's daily air monitoring log. The daily air monitoring log shall contain the following information for each sample:

a. Sampling and analytical method used;

b. Date sample collected;

c. Sample number;

d. Sample type: BZ = Breathing Zone (Personal), P = Preabatement, E = Environmental, C = Abatement Clearance;

e. Location/activity/name where sample collected;

f. Sampling pump manufacturer, model and serial number, beginning flow rate, end flow rate, average flow rate (L/min);

g. Calibration date, time, method, location, name of calibrator, signature;

h. Sample period (start time, stop time, elapsed time (minutes);

i. Total air volume sampled (liters);

j. Sample results (f/cc and S/mm square) if EPA methods are required for final clearance;

k. Laboratory name, location, analytical method, analyst, confidence level. In addition, the printed name and a signature and date block for the Industrial Hygienist who conducted the sampling and for the Industrial Hygienist who reviewed the daily air monitoring log verifying the accuracy of the information.

3.10 CLEARANCE CERTIFICATION

When asbestos abatement is complete, ACM waste is removed from the regulated areas, and final clean-up is completed, the NC will allow the

warning signs and boundary warning tape to be removed. HVAC, mechanical, and electrical systems shall be re-established in proper working order. The Contractor and the NC shall visually inspect all surfaces within the containment for residual material or accumulated debris. Reclean all areas showing dust or residual materials. The NC will certify in writing that the area is safe before unrestricted entry is permitted. The Government will have the option to perform monitoring to certify the areas are safe before entry is permitted.

3.11 CLEANUP AND DISPOSAL

3.11.1 Title to ACM Materials

ACM material resulting from abatement work, except as specified otherwise, shall become the property of the Contractor and shall be disposed of as specified and in accordance with applicable federal, state and local regulations.

3.11.2 Collection and Disposal of Asbestos

All ACM waste shall be collected including contaminated wastewater filters, scrap, debris, bags, containers, equipment, and asbestos contaminated clothing and placed in leak-tight 6 mil double bagged containers. Waste within the containers shall be wetted in case the container is breeched. Asbestos-containing waste shall be disposed of at an EPA, state and local approved asbestos landfill. For temporary storage, sealed impermeable containers shall be stored in an asbestos waste load-out unit or in a storage/transportation conveyance (i.e., dumpster, roll-off waste boxes, etc.) in a manner acceptable to and in an area assigned by the CO. Procedure for hauling and disposal shall comply with 40 CFR 61, Subpart M, state, regional, and local standards. All Friable ACM will be accompanied by a California Hazardous Waste Manifest. This manifest will be signed by a NASA representative responsible for tracking all hazardous waste removed from NASA Ames. All non-friable asbestos waste will be required to be accompanied by a non-hazardous waste manifest. Prior to the signature of both of these manifests, an inspection of the bagged waste, hauling vehicle and transporter's license will be inspected. Inform the NC at least 24 hours prior to need for this inspection.

3.11.3 Records and Management Plan

3.11.3.1 Asbestos Waste Shipment Records

Manifest must be inspected and signed by the NASA Representative prior to ACM Waste leaving the site.

3.11.3.2 Asbestos Management Plan

Provide a summary, in electronic form, of site activities (bulk samples, asbestos removed, repaired, encased, etc.) for updating the installation Asbestos Management Plan.

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS

Sheet_____ of _____

There is a separate data sheet for each individual work task.

1. WORK TASK DESIGNATION NUMBER _____
2. LOCATION OF WORK TASK_____
_____
3. BRIEF DESCRIPTION OF MATERIAL TO BE ABATED:_____
_____

   a. Type of Asbestos _____
   b. Percent asbestos content _____%

4. ABATEMENT TECHNIQUE TO BE USED_____
5. OSHA ASBESTOS CLASS DESIGNATION FOR WORK TASK_____
6. EPA NESHAP FRIABILITY DESIGNATION FOR WORK TASK
   Friable _____ Non-friable Category I _____
   Non-friable Category II_____
7. FORM _____ and CONDITION OF ACM: GOOD_____ FAIR_____ POOR_____
8. QUANTITY: METERS_____, SQUARE METERS_____
8a. QUANTITY: LINEAR FT._____, SQUARE FT._____
9. SET-UP DETAIL SHEET NUMBERS
   FOR WORK TASK _____, _____, _____, _____,
   _____, _____, _____, _____.

NOTES:

(1) Numeric sequence of individual work tasks (1,2,3,4, etc.) for each regulated area. Each category of EPA friability/OSHA class has a separate task.
(2) Specific location of work (building, floor, area, e.g., Building 1421, 2nd Floor, Rm 201)
(3) A description of material to be abated (example: horizontal pipe, cement wall panels, tile, stucco, etc.) type of asbestos (chrysotile, amosite, crocidolite, etc.); and % asbestos content.
(4) Technique to be used: Removal = REM; Encapsulation = ENCAP; Encasement = ENCAS; Enclosure = ENCL; Repair = REP.
(5) Class designation: Class I, II, III, or IV (OSHA designation).
(6) Friability of materials: Check the applicable EPA NESHAP friability designation.
(7) Form: Interior or Exterior Architectural = IA or EA; Mechanical/Electrical = ME.
Condition: Good = G; Fair = F; Poor = P.
(8) Quantity of ACM for each work task in meters or square meters.
(8a) Quantity of ACM for each work task in linear feet or square feet.

TABLE 3

NIOSH METHOD 7400

PCM ENVIRONMENTAL AIR SAMPLING PROTOCOL (NON-PERSONAL)

Sample Location	Minimum No. of Samples	Filter Pore Size (Note 1)	Min. Vol. (Note 2) (Liters)	Sampling Rate (liters/min.)
Inside Abatement Area	0.5/140 Square Meters (Notes 3 & 4)	0.45 microns	3850	2-16
Each Room in 1 Abatement Area Less than 140 Square meters		0.45 microns	3850	2-16
Field Blank	2	0.45 microns	0	0
Laboratory Blank	1	0.45 microns	0	0

Notes:

1. Type of filter is Mixed Cellulose Ester.

2. Ensure detection limit for PCM analysis is established at 0.005 fibers/cc.

3. One sample shall be added for each additional 140 square meters. (The corresponding I-P units are 5/1500 square feet).

4. A minimum of 5 samples are to be taken per abatement area, plus 2 field blanks.

TABLE 4

EPA AHERA METHOD: TEM AIR SAMPLING PROTOCOL

Location Sampled	Minimum No. of Samples	Filter Pore Size	Min. Vol. (Liters)	Sampling Rate (liters/min.)
Inside Abatement Area	5	0.45 microns	1500	2-16
Outside Abatement Area	5	0.45 microns	1500	2-16
Field Blank	2	0.45 microns	0	0
Laboratory Blank	1	0.45 microns	0	0

Notes:

1. Type of filter is Mixed Cellulose Ester.

2. The detection limit for TEM analysis is 70 structures/square mm.

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LEAD IN CONSTRUCTION

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for protection of workers, disposal of lead painted material.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA)

AIHA Z88.6	Respiratory Protection - Respirator Use-Physical Qualifications for Personnel

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.103	Respiratory Protection
29 CFR 1926.21	Safety Training and Education
29 CFR 1926.33	Access to Employee Exposure and Medical Records
29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.59	Hazard Communication
29 CFR 1926.62	Lead
29 CFR 1926.65	Hazardous Waste Operations and Emergency Response
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste

40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268	Land Disposal Restrictions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 178	Specifications for Packagings

UNDERWRITERS LABORATORIES (UL)

UL 586	Standard for High-Efficiency Particulate, Air Filter Units

1.3 DEFINITIONS

1.3.1 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period.

1.3.2 Area Sampling

Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel (approximately 5 to 6 feet above the floor).

1.3.3 Competent Person (CP)

As used in this section, refers to a person employed by the Contractor who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations and has the authority to take prompt corrective actions to control the lead hazard. A Certified Industrial Hygienist (CIH) certified by the American Board of Industrial Hygiene or a Certified Safety Professional (CSP) certified by the Board of Certified Safety Professionals is the best choice.

1.3.4 Contaminated Room

Refers to a room for removal of contaminated personal protective equipment (PPE).

1.3.5 Decontamination Shower Facility

That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal rooms, with a shower facility in between.

1.3.6 High Efficiency Particulate Arrestor (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated particulate. A high efficiency particulate filter demonstrates at least 99.97 percent efficiency against 0.3 micron or larger size particles.

1.3.7 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps. Excludes other forms of organic lead compounds.

1.3.8 Lead Control Area

A system of control methods to prevent the spread of lead dust, paint chips or debris to adjacent areas that may include temporary containment, floor or ground cover protection, physical boundaries, and warning signs to prevent unauthorized entry of personnel. HEPA filtered local exhaust equipment may be used as engineering controls to further reduce personnel exposures or building/outdoor environmental contamination.

1.3.9 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than eight hours in a work day, the PEL shall be determined by the following formula:

PEL (micrograms/cubic meter of air) = 400/No. hrs worked per day

1.3.10 Material Containing Lead/Paint with Lead (MCL/PWL)

Any material, including paint, which contains lead as determined by the testing laboratory using a valid test method. The requirements of this section does not apply if no detectable levels of lead are found using a quantitative method for analyzing paint or MCL using laboratory instruments with specified limits of detection (usually 0.01 percent). An X-Ray Fluorescence (XRF) instrument is not considered a valid test method.

1.3.11 Personal Sampling

Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employees' work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and centered at the nose or mouth of an employee.

1.3.12 Physical Boundary

Area physically roped or partitioned off around lead control area to limit unauthorized entry of personnel.

1.4 DESCRIPTION

1.4.1 Description of Work

See contracct for Scope of Work.

1.4.2 Coordination with Other Work

The contractor shall coordinate with work being performed in adjacent areas. Coordination procedures shall be explained in the Plan and shall describe how the Contractor will prevent lead exposure to other contractors and/or Government personnel performing work unrelated to lead activities.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Occupational and Environmental Assessment Data Report (if objective data is used to justify excluding the initial occupational exposure assessment

Lead Compliance Plan including CP approval (signature, date, and certification number)

Competent Person qualifications

Training Certification of workers and supervisors

Lead waste management plan

If used, written evidence that TSD is approved for lead disposal

Certification of Medical Examinations

SD-06 Test Reports

Sampling results

Occupational and Environmental Assessment Data Report

SD-07 Certificates

Testing laboratory qualifications

SD-11 Closeout Submittals

Completed and signed hazardous waste manifest from treatment or disposal facility

Waste turn-in documents or weight tickets for non-hazardous wastes that are disposed of at sanitary or construction and demolition landfills

1.6 QUALITY ASSURANCE

1.6.1 Qualifications

1.6.1.1 Competent Person (CP)

Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph entitled "Competent Person (CP) Responsibilities." Provide documented construction project-related

experience with implementation of OSHA's Lead in Construction standard (29 CFR 1926.62) which shows ability to assess occupational and environmental exposure to lead, experience with the use of respirators, personal protective equipment and other exposure reduction methods to protect employee health. Submit proper documentation that the CP is trained and certified in accordance with federal, State, and local laws. The competent person shall be a licensed lead-based paint abatement Supervisor in the State of California.

1.6.1.2 Training Certification

Submit a certificate for each worker and supervisor, signed and dated by the accredited training provider, stating that the employee has received the required lead training specified in 29 CFR 1926.62(l)and is certified to perform or supervise deleading, lead removal or demolition activities in the State of California.

1.6.1.3 Third Party Consultant Qualifications

Submit the name, address and telephone number of any third party consultant selected to perform the wipe sampling for determining concentrations of lead in dust. Submit proper documentation that the consultant is trained and certified as an inspector technician or inspector/risk assessor by the USEPA authorized State (or local) certification and accreditation program.

1.6.2 Requirements

1.6.2.1 Competent Person (CP) Responsibilities

a. Verify training meets all federal, State, and local requirements.

b. Review and approve Lead Compliance Plan for conformance to the applicable referenced standards.

c. Continuously inspect PWL or MCL work for conformance with the approved plan.

d. Perform (or oversee performance of) air sampling. Recommend upgrades or downgrades (whichever is appropriate based on exposure) on the use of PPE (respirators included) and engineering controls.

e. Ensure work is performed in strict accordance with specifications at all times.

f. Control work to prevent hazardous exposure to human beings and to the environment at all times.

g. Supervise final cleaning of the lead control area, take clearance wipe samples if necessary; review clearance sample results and make recommendations for further cleaning.

h. Certify the conditions of the work as called for elsewhere in this specification.

1.6.2.2 Lead Compliance Plan

Submit a detailed job-specific plan of the work procedures to be used in the disturbance of PWL or MCL. The plan shall include a sketch showing the location, size, and details of lead control areas, critical barriers,

physical boundaries, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include a description of equipment and materials, work practices, controls and job responsibilities for each activity from which lead is emitted. Include in the plan, eating, drinking, smoking, hygiene facilities and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and dust containing lead and debris, air sampling, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that lead is not released outside of the lead control area. Include site preparation, cleanup and clearance procedures, if needed. Include occupational and environmental sampling, training and strategy, sampling and analysis strategy and methodology, frequency of sampling, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan. Include a description of arrangements made among contractors on multicontractor worksites to inform affected employees and to clarify responsibilities to control exposures.

In occupied buildings, the plan shall also include an occupant protection program that describes the measures that will be taken during the work to notify and protect the building occupants.

1.6.2.3 Occupational and Environmental Assessment Data Report

If initial monitoring is necessary, submit occupational and environmental sampling results to the Contracting Officer within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.

In order to reduce the full implementation of 29 CFR 1926.62, the Contractor shall provide documentation. Submit a report that supports the determination to reduce full implementation of the requirements of 29 CFR 1926.62 and supporting the Lead Compliance Plan.

a. The initial monitoring shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead for stated work.

b. Submit worker exposure data gathered during the task based trigger operations of 29 CFR 1926.62 with a complete process description. This includes manual demolition, manual scraping, manual sanding, heat gun, power tool cleaning, rivet busting, cleanup of dry expendable abrasives, abrasive blast enclosure removal, abrasive blasting, welding, cutting and torch burning where lead containing coatings are present.

c. The initial assessment shall determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the lead compliance plan per 29 CFR 1926.62.

1.6.2.4 Medical Examinations

Initial medical surveillance as required by 29 CFR 1926.62 shall be made available to all employees exposed to lead at any time (1 day) above the action level. Full medical surveillance shall be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records shall show that employees meet the medical

surveillance requirements of 29 CFR 1926.33, 29 CFR 1926.62 and 29 CFR 1926.103. Provide medical surveillance to all personnel exposed to lead as indicated in 29 CFR 1926.62. Maintain complete and accurate medical records of employees for the duration of employment plus 30 years.

1.6.2.5 Training

Train each employee performing work that disturbs lead, who performs MCL/PWL disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 29 CFR 1926.21, 29 CFR 1926.62, and State and local regulations where appropriate.

1.6.2.6 Respiratory Protection Program

a. Provide each employee required to wear a respirator a respirator fit test at the time of initial fitting and at least annually thereafter as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by AIHA Z88.6, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

1.6.2.7 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

1.6.2.8 Lead Waste Management

The Lead Waste Management Plan shall comply with applicable requirements of federal, State, and local hazardous waste regulations. and address:

a. Identification and classification of wastes associated with the work.

b. Estimated quantities of wastes to be generated and disposed of.

c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and a 24-hour point of contact.

d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.

g. Work plan and schedule for waste containment, removal and disposal. Proper containment of the waste includes using acceptable waste containers (e.g., 55-gallon drums) as well as proper marking/labeling of the containers. Wastes shall be cleaned up and containerized daily.

h. Include any process that may alter or treat waste rendering a hazardous waste non hazardous.

i. Unit cost for hazardous waste disposal according to this plan.

1.6.2.9 Environmental, Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of federal, State, and local authorities regarding lead. Comply with the applicable requirements of the current issue of 29 CFR 1926.62. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply. The following local and State laws, ordinances, criteria, rules and regulations regarding removing, handling, storing, transporting, and disposing of lead-contaminated materials apply:

Licensing in the state of California is required.

1.6.3 Pre-Construction Conference

Along with the CP, meet with the Contracting Officer to discuss in detail the Lead Waste Management Plan and the Lead Compliance Plan, including procedures and precautions for the work.

1.7 EQUIPMENT

1.7.1 Respirators

Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust, fume and mist. Respirators shall comply with the requirements of 29 CFR 1926.62.

1.7.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with proper disposable protective whole body clothing, head covering, gloves, eye, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.

1.7.3 Rental Equipment Notification

If rental equipment is to be used during PWL or MCL handling and disposal, notify the rental agency in writing concerning the intended use of the equipment.

1.7.4 Vacuum Filters

UL 586 labeled HEPA filters.

1.7.5 Equipment for Government Personnel

Furnish the Contracting Officer with two complete sets of personal protective equipment (PPE) daily, as required herein, for entry into and inspection of the lead removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, eye, and hand protection. PPE shall remain the property of the Contractor. The Government will provide respiratory protection for the Contracting Officer.

1.8 PROJECT/SITE CONDITIONS

1.8.1 Protection of Existing Work to Remain

Perform work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better as determined by the Contracting Officer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Protection

3.1.1.1 Notification

a. Notify the Contracting Officer 5 days prior to the start of any lead work.

3.1.1.2 Lead Control Area

a. Physical Boundary - Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that lead will not escape outside of the lead control area.

b. Warning Signs - Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

3.1.1.3 Furnishings

The Government will remove furniture and equipment from the building before lead work begins.

3.1.1.4 Heating, Ventilating and Air Conditioning (HVAC) Systems

Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6 mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area. Provide temporary HVAC system for areas in which HVAC has been shut down outside the lead control area.

3.1.1.5 Decontamination Shower Facility

Provide clean and contaminated change rooms and shower facilities in accordance with this specification and 29 CFR 1926.62.

3.1.1.6 Eye Wash Station

Where eyes may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes shall be provided

within the work area.

3.1.1.7 Mechanical Ventilation System

a. To the extent feasible, use local exhaust ventilation or other collection systems, approved by the CP. Local exhaust ventilation systems shall be evaluated and maintained in accordance with 29 CFR 1926.62.

b. Vent local exhaust outside the building and away from building ventilation intakes or ensure system is connected to HEPA filters.

c. Use locally exhausted, power actuated tools or manual hand tools.

3.1.1.8 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

3.2 ERECTION

3.2.1 Lead Control Area Requirements

Establish a lead control area by completely establishing barriers and physical boundaries around the area or structure where PWL or MCL removal operations will be performed.

3.3 APPLICATION

3.3.1 Lead Work

Perform lead work in accordance with approved Lead Compliance Plan. Use procedures and equipment required to limit occupational exposure and environmental contamination with lead when the work is performed in accordance with 29 CFR 1926.62, and as specified herein. Dispose of all PWL or MCL and associated waste in compliance with federal, State, and local requirements.

3.3.2 Paint with Lead or Material Containing Lead Removal

Manual or power sanding or grinding of lead surfaces or materials is not permitted unless tools are equipped with HEPA attachments or wet methods. The dry sanding or grinding of surfaces that contain lead is prohibited. Provide methodology for removing lead in the Lead Compliance Plan. Select lead removal processes to minimize contamination of work areas outside the control area with lead-contaminated dust or other lead-contaminated debris or waste and to ensure that unprotected personnel are not exposed to hazardous concentrations of lead. Describe this removal process in the Lead Compliance Plan.

3.3.2.1 Paint with Lead or Material Containing Lead - Indoor Removal

Perform manual removal and thermal cutting in the lead control areas using enclosures, barriers or containments and powered locally exhausted tools. Collect residue debris for disposal in accordance with federal, State, and local requirements.

3.3.2.2 Paint with Lead or Material Containing Lead - Outdoor Removal

Perform outdoor removal as indicated in federal, State, and local regulations and in the Lead Compliance Plan. The worksite preparation (barriers or containments) shall be job dependent and presented in the Lead Compliance Plan.

3.3.3 Personnel Exiting Procedures

Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn in the control area:

a. Vacuum all clothing before entering the contaminated change room.

b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.

c. Shower.

c. Wash hands and face at the site, don appropriate disposable or uncontaminated reusable clothing, move to an appropriate shower facility, shower.

d. Change to clean clothes prior to leaving the clean clothes storage area.

3.4 FIELD QUALITY CONTROL

3.4.1 Tests

3.4.1.1 Air and Wipe Sampling

Conduct sampling for lead in accordance with 29 CFR 1926.62 and as specified herein. Air and wipe sampling shall be directed or performed by the CP.

a. The CP shall be on the job site directing the air and wipe sampling and inspecting the PWL or MCL removal work to ensure that the requirements of the contract have been satisfied during the entire PWL or MCL operation.

b. Collect personal air samples on employees who are anticipated to have the greatest risk of exposure as determined by the CP. In addition, collect air samples on at least twenty-five percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.

c. Submit results of air samples, signed by the CP, within 72 hours after the air samples are taken.

d. Conduct area air sampling daily, on each shift in which lead-based paint removal operations are performed, in areas immediately adjacent to the lead control area. Sufficient area monitoring shall be conducted to ensure unprotected personnel are not exposed at or above 30 micrograms per cubic meter of air. If 30 micrograms per cubic meter of air is reached or exceeded, stop work, correct the conditions(s) causing the increased levels. Notify the Contracting Officer immediately. Determine if condition(s) require any further change in

work methods. Removal work shall resume only after the CP and the Contracting Officer give approval.

3.4.1.2 Testing of Material Containing Lead Residue

Test residue in accordance with 40 CFR 261 for hazardous waste.

3.5 CLEANING AND DISPOSAL

3.5.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of dust and debris. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use pressurized air to clean up the area. At the end of each shift and when the lead operation has been completed, clean the controlled area of visible contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the Lead Compliance Plan. Reclean areas showing dust or debris. After visible dust and debris is removed, wet wipe and HEPA vacuum all surfaces in the controlled area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The CP shall then certify in writing that the area has been cleaned of lead contamination before clearance testing.

3.5.1.1 Clearance Certification

NASA's onsite Health and Safety lead professional will perform a visual inspection of all lead work. Lead based paint work that is removed to elevate a lead hazard may need lead wipe samples to determine if the area is clean. This deterrent will be on a project by project basis.

3.5.2 Disposal

a. All material, whether hazardous or non-hazardous shall be disposed in accordance with all laws and provisions and all federal, State or local regulations. Ensure all waste is properly characterized. The result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.

b. Contractor is responsible for segregation of waste. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing that may produce airborne concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62 and 40 CFR 261.

c. Dispose of lead-contaminated material classified as hazardous waste at an EPA approved hazardous waste treatment, storage, or disposal facility off Government property.

d. Store waste materials in U.S. Department of Transportation (49 CFR 178) approved 55 gallon drums. Properly label each drum to identify the type of waste (49 CFR 172) and the date the drum was filled. For hazardous waste, the collection drum requires marking/labeling in accordance with 40 CFR 262 during the accumulation/collection timeframe. The Contracting Officer or an authorized representative will assign an area for interim storage of waste-containing drums. Do not store hazardous waste drums in interim storage longer than 90 calendar days from the date affixed to each drum.

e. Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

3.5.2.1 Disposal Documentation

Submit written evidence to demonstrate the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA, State or local regulatory agencies. Submit one copy of the completed hazardous waste manifest, signed and dated by the initial transporter in accordance with 40 CFR 262. Contractor shall provide a certificate that the waste was accepted by the disposal facility.

3.5.2.2 Payment for Hazardous Waste

Payment for disposal of hazardous and non-hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility certifying the amount of lead-containing materials or non-hazardous waste delivered is returned and a copy is furnished to the Government.

-- End of Section --

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SECTION 03 30 00

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for cast-in-place concrete.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ACI INTERNATIONAL (ACI)

ACI/MCP-1	Manual of Concrete Practice Part 1
ACI/MCP-2	Manual of Concrete Practice Part 2
ACI/MCP-3	Manual of Concrete Practice Part 3
ACI/MCP-4	Manual of Concrete Practice Part 4

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	Basic Hardboard

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A185/A185M	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A496/A496M	Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A497/A497M	Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete

ASTM A615/A615M	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706/A706M	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A82/A82M	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM C 1017/C 1017M	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1107/C 1107M	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 143/C 143M	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150/C 150M	Standard Specification for Portland Cement
ASTM C 156	Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C 171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C 173/C 173M	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 311	Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
ASTM C 33/C 33M	Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	Standard Specification for Chemical

	Admixtures for Concrete
ASTM C 618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 881/C 881M	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 920	Standard Specification for Elastomeric Joint Sealants
ASTM C 932	Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering
ASTM C 94/C 94M	Standard Specification for Ready-Mixed Concrete
ASTM C 989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C172/C172M	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231/C231M	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM D 1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 5759	Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM D 6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM D 7116	Standard Specification for Joint Sealants, Hot Applied, Jet Fuel Resistant Types, for Portland Cement Concrete Pavement
ASTM E 329	Standard Specification for Agencies Engaged in the Testing and/or Inspection

	of Materials Used in Construction
CONCRETE REINFORCING STEEL INSTITUTE (CRSI)	
CRSI 10MSP	Manual of Standard Practice
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)	
NIST PS 1	DOC Voluntary Product Standard PS 1-07, Structural Plywood
U.S. ARMY CORPS OF ENGINEERS (USACE)	
COE CRD-C 572	Corps of Engineers Specifications for Polyvinylchloride Waterstops
U.S. DEPARTMENT OF COMMERCE (DOC)	
DOC/NIST PS1	Construction and Industrial Plywood with Typical APA Trademarks
U.S. GENERAL SERVICES ADMINISTRATION (GSA)	
FS MMM-A-001993	Adhesive, Epoxy, Flexible, Filled (For Binding, Sealing, and Grouting)
FS SS-S-1614	Sealants, Joint,Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Tar Concrete Pavements
FS SS-S-200	Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

1.3 DEFINITIONS

a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, ground granulated blast-furnace slag.

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

d. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desited work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcing steel

Reproductions of contract drawings are unacceptable.

Provide erection drawings for concrete reinforcing that show placement of reinforcement and accessories, with reference to the contract drawings.

SD-03 Product Data

Materials for curing concrete
Joint sealants

Submit manufacturer's product data, indicating VOC content. Manufacturer's catalog data for the following items must include printed instructions for admixtures, bonding agents, epoxy-resin adhesive binders, waterstops, and liquid chemical floor hardeners.

Joint filler
Recycled Aggregate Materials
Cement
Portland Cement
Ready-Mix Concrete
Vapor retarder and Vapor barrierBonding Materials
Concrete Curing Materials
Reinforcement
Reinforcement Materials

WaterstopsWood Forms

Biodegradable Form Release Agent

Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

Footing mat finish sampleSubmit the following samples:Three samples of each type waterstop, 1/2 inch long.

Dumbbell TypeSD-05 Design Data

Concrete mix design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, ground slag and admixtures; and applicable reference specifications. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the COR. Indicate clearly in the submittal where each mix design is used when more than one

mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes. Submit copies of the fly ash, and pozzolan test results, in addition. The approval of fly ash, and pozzolan test results must be within 6 months of submittal date. Obtain acknowledgement of receipt prior to concrete placement.

SD-06 Test Reports

Concrete mix design

Fly ash

Pozzolan

Ground granulated blast-furnace slag

Compressive strength tests

Slump

Air Entrainment

SD-08 Manufacturer's Instructions

Fly ash

Ground granulated blast-furnace slag

1.5 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the COR.

1.6 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until vapor retarder, vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI/MCP-2 for job site storage of materials. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store concrete curing compounds or sealers in occupied spaces.

1.6.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.7 QUALITY ASSURANCE

1.7.1 Drawings

1.7.1.1 Reinforcing Steel

ACI/MCP-4. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

1.7.2 Control Submittals

1.7.2.1 Curing Concrete Elements

Submit proposed materials and methods for curing concrete elements.

1.7.2.2 Form Removal Schedule

Submit schedule for form removal indicating element and minimum length of time for form removal.

1.7.2.3 VOC Content for Form Release Agents, Curing Compounds, and Concrete Penetrating Sealers

Submit certification for the form release agent, curing compounds, and concrete penetrating sealers that indicate the VOC content of each product.

1.7.2.4 Material Safety Data Sheets

Submit Material Safety Data Sheets (MSDS) for all materials that are regulated for hazardous health effects. Prominently post the MSDS at the construction site.

1.7.3 Test Reports

1.7.3.1 Concrete Mix Design

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix must be suitable for the job conditions. Include mill test and all other test for cement, aggregates, and admixtures in the laboratory test reports. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Submit test reports along with the concrete mix design. Obtain approval before concrete placement.

1.7.3.2 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C 618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date. Submit manufacturer's policy statement on fly ash use in concrete.

1.7.3.3 Ground Granulated Blast-Furnace Slag

Submit test results in accordance with ASTM C 989 for ground granulated blast-furnace slag. Submit test results performed within 6 months of submittal date. Submit manufacturer's policy statement on slag use in concrete.

1.7.4 Field Samples

1.7.4.1 Mat Footing Finish Sample

Install minimum of 10 foot by 10 foot slab. Finish as required by specification.

1.8 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

Perform concrete testing by an approved laboratory and inspection service experienced in sampling and testing concrete. Testing agency must meet the requirements of ASTM E 329.

1.9 QUALIFICATIONS FOR WELDING WORK

Approval shall be obtained before welding reinforcement.

PART 2 PRODUCTS

2.1 MATERIALS FOR FORMS

Provide wood, plywood, plastic, carton, or steel. Use plywood or steel forms where a smooth form finish is required.

2.1.1 Wood Forms

Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with DOC/NIST PS1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining.

2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.2 FORM TIES AND ACCESSORIES

The use of wire alone is prohibited. Provide form ties and accessories that do not reduce the effective cover of the reinforcement.

2.2.1 Polyvinylchloride Waterstops

COE CRD-C 572.

2.3 CONCRETE

2.3.1 Contractor-Furnished Mix Design

ACI/MCP-1, ACI/MCP-2, and ACI/MCP-3 except as otherwise specified. Indicate the compressive strength (f'c) of the concrete for each portion of the structure(s) and as specified below.

Location	f'c (Min. 28-Day Comp. Strength) (psi)	ASTM C 33/C 33M Maximum Nominal Aggregate (Size No.)	Range of Slump (inches)	Maximum Water-Cement Ratio (by weight)	Air Entr. (percent)
Footing	4000	57	4	0.50	6
Walks, Curbs, Gutters, Utility Str, Pavement	3000	67	4	0.5	5

Maximum slump shown above may be increased 1 inch for methods of consolidation other than vibration. Slump may be increased to 8 inches when superplasticizers are used. Provide air entrainment using air-entraining admixture. Provide air entrainment within plus or minus 1.5 percent of the value specified.

2.3.1.1 Mix Proportions for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified are the responsibility of the Contractor. Base mixture proportions on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M. Samples of all materials used in mixture proportioning studies must be representative of those proposed for use in the project and must be accompanied by the manufacturer's or producer's test report indicating compliance with these specifications. Base trial mixtures having proportions, consistencies, and air content suitable for the work on methodology described in ACI/MCP-1. In the trial mixture, use at least three different water-cement ratios for each type of mixture, which must produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratio required must be based on equivalent water-cement ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan, and ground granulated blast-furnace slag by weight equivalency method. Design laboratory trial mixture for maximum permitted slump and air content. Each combination of material proposed for use must have separate trial mixture, except for accelerator or retarder use can be provided without separate trial mixture. Report the temperature of concrete in each trial batch. For each water-cement ratio, at least three test cylinders for each test age must be made and cured in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M for 7 and 28 days. From these results, plot a curve showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, plot a curve showing the relationship between 7 and 28 day strengths.

2.3.1.2 Required Average Strength of Mix Design

The selected mixture must produce an average compressive strength exceeding the specified strength by the amount indicated in ACI/MCP-2. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation must be calculated and the required average compressive strength must be determined in accordance with ACI/MCP-2. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength must follow

ACI/MCP-2 requirements.

2.3.2 Ready-Mix Concrete

Provide concrete that meets the requirements of ASTM C 94/C 94M.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by ASTM C 94/C 94M:

Type and brand cement

Cement content in 95-pound bags per cubic yard of concrete

Maximum size of aggregate

Amount and brand name of admixtures

Total water content expressed by water/cement ratio

2.3.3 Concrete Curing Materials

2.3.3.1 Absorptive Cover

Provide burlap cloth cover for curing concrete made from jute or kenaf, weighing 10 ounces plus or minus 3 percent per square yard when clean and dry, conforming to ASTM C 171, Class 3; or cover may be cotton mats as approved.

2.3.3.2 Moisture-Retaining Cover

Provide waterproof paper cover for curing concrete conforming to ASTM C 171, regular or white, or polyethylene sheeting conforming to ASTM C 171, or polyethylene-coated burlap consisting of a laminate of burlap and a white opaque polyethylene film permanently bonded to the burlap; burlap must conform to ASTM C 171, Class 3, and polyethylene film must conform to ASTM C 171. When tested for water retention in accordance with ASTM C 156, weight of water lost 72 hours after application of moisture retaining covering material must not exceed 0.039 gram per square centimeter of the mortar specimen surface.

2.3.3.3 Membrane-Forming Curing Compound

Provide liquid type compound conforming to ASTM C 309, Type 1, clear, Type 1D with fugitive dye for interior work and Type 2, white, pigmented for exterior work.

2.4 MATERIALS

2.4.1 Cement

ASTM C 150/C 150M, Type I or II. Provide blended cement that consists of a mixture of ASTM C 150/C 150M, Type II, cement and one of the following materials: ASTM C 618 pozzolan or fly ash, ASTM C 989 ground granulated blast-furnace slag. For portland cement manufactured in a kiln fueled by hazardous waste, maintain a record of source for each batch. Supplier must certify that no hazardous waste is used in the fuel mix or raw materials. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.4.1.1 Fly Ash and Pozzolan

ASTM C 618, Type F, or C, except that the maximum allowable loss on ignition must be 6 percent for Types N and F. Add with cement. Fly ash content must be a minimum of 25 percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum amount of fly ash permittable that meets the code requirements for cement content. Report the chemical analysis of the fly ash in accordance with ASTM C 311. Evaluate and classify fly ash in accordance with ASTM D 5759.

High contents of supplementary cementitious materials can have some detrimental effects on the concrete properties, such as slowing excessively the strength gain rate, and delaying and increasing the difficulty of finishing. The recommended maximum content (by weight of the total cementitious material) for these materials are:

a. For GGBF slag: 50 percent

b. For fly ash or natural pozzolan: 40 percent (25 percent in cold climates)

2.4.1.2 Ground Granulated Blast-Furnace Slag

ASTM C 989, Grade 100. Slag content must be a minimum of 25 percent by weight of cementitious material.

2.4.1.3 Portland Cement

Provide cement that conforms to ASTM C 150/C 150M, Type I, IA, II, or IIA. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

2.4.2 Water

Minimize the amount of water in the mix. The amount of water must not exceed 45 percent by weight of cementitious materials (cement plus pozzolans), and in general, improve workability by adjusting the grading rather than by adding water. Water must be fresh, clean, and potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

2.4.3 Aggregates

ASTM C 33/C 33M, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Provide aggregates that do not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.4.3.1 Recycled Aggregate Materials

Use a minimum of 25 percent recycled aggregate, depending on local availability and conforming to requirements of the mix design. Recycled aggregate to include: recovered concrete recovered porcelain recovered stone that meets the aggregate requirements specified. Submit recycled material request with the aggregate certification submittals and do not use until approved by the COR.

2.4.4 Nonshrink Grout

ASTM C 1107/C 1107M.

2.4.5 Admixtures

ASTM C 494/C 494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures.

2.4.5.1 Air-Entraining

ASTM C260/C260M.

2.4.5.2 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C 494/C 494M, Type F and ASTM C 1017/C 1017M.

2.4.5.3 Pozzolan

Provide fly ash or other pozzolans used as admixtures that conform to ASTM C 618.

2.4.6 Materials for Curing Concrete

Use water-based curing compounds, sealers, and coatings with low (maximum 160 grams/liter, less water and less exempt compounds) zero VOC content.

Consider the use of water based or vegetable or soy based curing agents in lieu of petroleum based products. Consider agents that are not toxic and emit low or no Volatile Organic Compounds (VOC). Consider the use of admixtures that offer high performance to increase durability of the finish product but also have low toxicity and are made from bio-based materials such as soy, and emit low levels of Volatile Organic Compounds (VOC).

2.4.6.1 Impervious Sheeting

ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.4.6.2 Pervious Sheeting

AASHTO M 182.

2.4.6.3 Liquid Membrane-Forming Compound

ASTM C 309, white-pigmented, Type 2, Class B.

2.4.7 Liquid Chemical Sealer-Hardener Compound

Provide surface treatments containing certain chemicals, including sodium silicate and the fluosilicates of magnesium and zinc. Provide compound that does not reduce the adhesion of resilient flooring, tile, paint, roofing, waterproofing, or other material applied to concrete.

2.4.8 Expansion/Contraction Joint Filler

ASTM D 1751, ASTM D 1752, cork or 100 percent post-consumer paper meeting ASTM D 1752 (subparagraphs 5.1 to 5.4). Material must be 1/2 inch thick, unless otherwise indicated.

2.4.8.1 Preformed Joint Filler Strips

Provide nonextruding and resilient bituminous type filler strips conforming to ASTM D 1751.

Provide nonextruding and resilient nonbituminous type filler strips conforming to ASTM D 1752, Type I or II.

2.4.9 Joint Sealants

Use concrete penetrating sealers with a low (maximum 100 grams/liter, less water and less exempt compounds) VOC content.

2.4.9.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D 6690 or ASTM C 920, Type M, Class 25, Use T. ASTM D 7116 for surfaces subjected to jet fuel.

2.4.9.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C 920, Type M, Grade NS, Class 25, Use T. FS SS-S-1614.

2.4.9.3 Waterstops

Provide waterstops that are flat dumbbell type, not less than 3/16 inch for widths up to 5 inches, and not less than 3/8 inch for widths 5 inches and over.

2.4.9.4 Joint Sealant Compound

Provide cold-applied, two-component, elastomeric polymer type compound conforming to FS SS-S-200.

2.4.10 Epoxy Bonding Compound

ASTM C 881/C 881M. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Provide Class A if placement temperature is below 40 degrees F; Class B if placement temperature is between 40 and 60 degrees F; or Class C if placement temperature is above 60 degrees F.

2.4.11 Biodegradable Form Release Agent

Provide form release agent that is colorless, biodegradable, and water-based, with a zero VOC content. A minimum of 85 percent of the total product must be biobased material. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene.

2.5 REINFORCEMENT

Fabrics, connectors, and chairs.

2.5.1 Reinforcing Bars

ACI/MCP-2 unless otherwise specified. Use deformed steel. ASTM A615/A615M Grade 60; or Grade 60. ASTM A706/A706M.

2.5.2 Wire

ASTM A82/A82M or ASTM A496/A496M.

2.5.2.1 Welded Wire Fabric

ASTM A185/A185M or ASTM A497/A497M.

2.5.2.2 Steel Wire

Wire must conform to ASTM A82/A82M.

2.5.3 Reinforcing Bar Supports

Provide bar ties and supports of coated or non corrodible material. Use recycled plastic with 100 percent recycled content. Use engineered resins from recycled ABS plastic, polycarbonates, and fiberglass.

2.5.4 Supports for Reinforcement

Supports include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcing bars and wire fabric in place.

Provide wire bar type supports conforming to ACI/MCP-3, ACI/MCP-4 and CRSI 10MSP.

Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

2.6 BONDING MATERIALS

2.6.1 Concrete Bonding Agent

Provide aqueous-phase, film-forming, nonoxidizing, freeze and thaw-resistant compound agent suitable for brush or spray application conforming to ASTM C 932.

2.6.2 Epoxy-Resin Adhesive Binder

Provide two-component, epoxy-polysulfide polymer type binder with an amine-type curing-agent conforming to FS MMM-A-001993, Type I or ASTM C 881/C 881M.

PART 3 EXECUTION

3.1 EXAMINATION

Do not begin installation until substrates have been properly constructed; verify that substrates are plumb and true.

If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before processing.

Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Architect/Engineer and wait for instructions before beginning installation.

3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

3.2.1 General

Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings

When subgrade material is semiporous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited. When subgrade material is porous, seal subgrade surface by covering surface with specified vapor retarder; this may also be used over semiporous, dry subgrade material instead of water sprinkling.

3.2.3 Subgrade Under Slabs on Ground

Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.

Previously constructed subgrade or fill must be cleaned of foreign materials and inspected by the Contractor for adequate compaction and surface tolerances as specified.

Actual density of top 12 inches of subgrade soil material-in-place must not be less than the following percentages of maximum density of same soil material compacted at optimum moisture content in accordance with ASTM D 1557.

SOIL MATERIAL	PERCENT MAXIMUM DENSITY
Capillary water barrier	100
Cohesionless soil material	100
Cohesive soil material	95

Finish surface of capillary water barrier under interior slabs on ground must not show deviation in excess of 1/4 inch when tested with a 10-foot straightedge parallel with and at right angles to building lines.

Finished surface of subgrade or fill under exterior slabs on ground must not be more than 0.02-foot above or 0.10-foot below elevation indicated.

Prepare subgrade or fill surface under exterior slabs on ground as specified for subgrade under foundations and footings.

3.2.4 Formwork

Complete and approve formwork. Remove debris and foreign material from interior of forms before start of concrete placing.

3.2.5 Edge Forms and Screed Strips for Slabs

Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

3.2.6 Reinforcement and Other Embedded Items

Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.

3.3 FORMS

ACI/MCP-2. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water must be watertight.

3.3.1 General

Construct forms to conform, within the tolerances specified, to shapes dimensions, lines, elevations, and positions of cast-in-place concrete members as indicated. Forms must be supported, braced, and maintained sufficiently rigid to prevent deformation under load.

3.3.2 Design and Construction of Formwork

Provide formwork design and construction that conforms to ACI/MCP-2, Chapter 4.

Provide forms that are tight to prevent leakage of cement paste during concrete placing.

Support form facing materials by structural members spaced close to prevent deflection of form facing material. Fit forms placed in successive units for continuous surfaces to accurate alignment to ensure a smooth completed surface within the tolerances specified. Where necessary to maintain the tolerances specified, such as long spans where immediate supports are not possible, camber formwork for anticipated deflections in formwork due to weight and pressure of fresh concrete and to construction loads.

Chamfer exposed joints, edges, and external corners a minimum of 3/4 inch by moldings placed in corners of column, beam, and wall forms.

Provide shores and struts with a positive means of adjustment capable of

taking up formwork settlement during concrete placing operations. Obtain adjustment with wedges or jacks or a combination thereof. When adequate foundations for shores and struts cannot be secured, provide trussed supports.

Provide temporary openings in wall forms, column forms, and at other points where necessary to permit inspection and to facilitate cleaning.

Provide forms that are readily removable without impact, shock, or damage to concrete.

3.3.3 Coating

Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

3.3.4 Reuse

Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.

3.3.5 Forms for Standard Rough Form Finish

Give rough form finish concrete formed surfaces that are to be concealed by other construction, unless otherwise specified.

Form facing material for standard rough form finish must be the specified concrete form plywood or other approved form facing material that produces concrete surfaces equivalent in smoothness and appearance to that produced by new concrete form plywood panels.

For concrete surfaces exposed only to the ground, undressed, square-edge, 1-inch nominal thickness lumber may be used. Provide horizontal joints that are level and vertical joints that are plumb.

3.3.6 Form Ties

Provide ties that are factory fabricated metal, adjustable in length, removable or snap-off type that do allow form deflection or do not spall concrete upon removal. Portion of form ties remaining within concrete after removal of exterior parts must be at least 1-1/2 inches back from concrete surface. Provide form ties that are free of devices that leave a hole larger than 7/8 inch or less than 1/2 inch in diameter in concrete surface. Form ties fabricated at the project site or wire ties of any type are not acceptable.

3.3.7 Tolerances for Form Construction

Construct formwork to ensure that after removal of forms and prior to patching and finishing of formed surfaces, provide concrete surfaces in accordance with tolerances specified in ACI/MCP-1 and ACI/MCP-2.

3.3.8 Removal of Forms and Supports

After placing concrete, forms must remain in place for the time periods specified in ACI/MCP-4. Do not remove forms and shores (except those used for slabs on grade and slip forms) until the COR determines that the

concrete has gained sufficient strength to support its weight and superimposed loads. Base such determination on compliance with one of the following:

a. The plans and specifications stipulate conditions for removal of forms and shores, and such conditions have been followed, or

b. The concrete has been properly tested with an appropriate ASTM standard test method designed to indicate the concrete compressive strength, and the test results indicate that the concrete has gained sufficient strength to support its weight and superimposed loads.

Prevent concrete damage during form removal. Clean all forms immediately after removal.

3.3.8.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C 39/C 39M test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of 85 percent of the design strength.

3.4 WATERSTOP SPLICES

Fusion weld in the field.

3.5 FORMED SURFACES

3.5.1 Preparation of Form Surfaces

Coat contact surfaces of forms with form-coating compound before reinforcement is placed. Provide a commercial formulation form-coating compound that does not bond with, stain, nor adversely affect concrete surfaces and impair subsequent treatment of concrete surfaces that entails bonding or adhesion nor impede wetting of surfaces to be cured with water or curing compounds. Do not allow excess form-coating compound to stand in puddles in the forms nor to come in contact with concrete against which fresh concrete is placed. Make thinning of form-coating compound with thinning agent of the type, in the amount, and under the conditions recommended by form-coating compound manufacturer's printed or written directions.

3.5.2 Tolerances

ACI/MCP-4 and as indicated.

3.5.3 As-Cast Form

Provide form facing material producing a smooth, hard, uniform texture on the concrete. Arrange facing material in an orderly and symmetrical manner and keep seams to a practical minimum. Support forms as necessary to meet required tolerances. Do not use material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which can impair the texture of the concrete surface.

3.6 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI/MCP-2. Provide bars, wire fabric, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement must

not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

3.6.1 General

Provide details of reinforcement that are in accordance with ACI/MCP-3 and ACI/MCP-4 and as specified.

3.6.2 Vapor Retarder and Vapor Barrier

Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 12 inches and tape or cement joints. Remove torn, punctured, or damaged vapor retarder and vapor barrier material and provide with new vapor retarder and vapor barrier prior to placing concrete. Concrete placement must not damage vapor retarder and vapor barrier material.

3.6.3 Reinforcement Supports

Place reinforcement and secure with galvanized or non corrodible chairs, spacers, or metal hangers. For supporting reinforcement on the ground, use concrete or other non corrodible material, having a compressive strength equal to or greater than the concrete being placed.

3.6.4 Splicing

As indicated. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches. AWS D1.4/D1.4M. Approve welded splices prior to use.

3.6.5 Cover

ACI/MCP-2 for minimum coverage, unless otherwise indicated.

3.6.6 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.6.7 Construction Joints

Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.

3.6.8 Expansion Joints and Contraction Joints

Provide expansion joint at edges of interior floor slabs on grade abutting vertical surfaces, and as indicated. Make expansion joints 1/2 inch wide unless indicated otherwise. Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used. Provide contraction joints, either formed or saw cut or cut with a jointing tool,

to the indicated depth after the surface has been finished. Complete saw joints within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

3.6.9 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

Provide fabrication tolerances that are in accordance with ACI/MCP-1, ACI/MCP-2 and ACI/MCP-3.

Provide hooks and bends that are in accordance with ACI/MCP-3 and ACI/MCP-4.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not be permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Tolerance on nominally square-cut, reinforcing bar ends must be in accordance with ACI/MCP-3.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

a. Bar lengths, depths, and bends beyond specified fabrication tolerances

b. Bends or kinks not indicated on drawings or approved shop drawings

c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required shape, form, and cross-section area.

3.6.10 Placing Reinforcement

Place reinforcement in accordance with ACI/MCP-3 and ACI/MCP-4.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire fabric on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than 1 inch from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 3-1/2 by 3-1/2 inches, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Contractor must cooperate with other trades in setting of anchor bolts, inserts, and other embedded items. Where conflicts occur between locating

reinforcing and embedded items, the Contractor must notify the COR so that conflicts may be reconciled before placing concrete. Anchors and embedded items must be positioned and supported with appropriate accessories.

3.6.11 Spacing of Reinforcing Bars

Spacing must be as indicated.

Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to approval.

3.7 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C 94/C 94M, and ACI/MCP-2, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.7.1 Measuring

Make measurements at intervals as specified in paragraphs entitled "Sampling" and "Testing."

3.7.2 Mixing

ASTM C 94/C 94M and ACI/MCP-2. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 84 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

3.7.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.8 PLACING CONCRETE

Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from

the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other. Position grade stakes on 10 foot centers maximum in each direction when pouring interior slabs and on 20 foot centers maximum for exterior slabs.

3.8.1 General Placing Requirements

Deposit concrete continuously or in layers of such thickness that no concrete is placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as specified. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation.

Concrete to receive other construction must be screeded to proper level to avoid excessive skimming or grouting.

Do not use concrete which becomes nonplastic and unworkable or does not meet quality control limits as specified or has been contaminated by foreign materials. Use of retempered concrete is permitted. Remove rejected concrete from the site.

3.8.2 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the COR. Excavation width must be a minimum of 4 inches greater than indicated.

3.8.3 Vibration

ACI/MCP-2. Furnish a spare, working, vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 4 inches in depth with high frequency mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate internal vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 20 inches apart. Penetrate the previously placed lift with the vibrator when more than one lift is required. Place concrete in 20 inch maximum vertical lifts. Use external vibrators on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.

3.8.4 Application of Epoxy Bonding Compound

Apply a thin coat of compound to dry, clean surfaces. Scrub compound into the surface with a stiff-bristle brush. Place concrete while compound is stringy. Do not permit compound to harden prior to concrete placement. Follow manufacturer's instructions regarding safety and health precautions when working with epoxy resins.

3.8.5 Pumping

ACI/MCP-2. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between

successive increments. Loss of slump in pumping equipment must not exceed 2 inches. Do no convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of course aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

3.8.6 Cold Weather

ACI/MCP-2. Do not allow concrete temperature to decrease below 50 degrees F Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 37 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application.

3.8.7 Hot Weather

Maintain required concrete temperature using Figure 2.1.5 in ACI/MCP-2 to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.8.8 Follow-up

Check concrete within 24 hours of placement for flatness, levelness, and other specified tolerances. Adjust formwork and placement techniques on subsequent pours to achieve specified tolerances.

3.8.9 Placing Concrete in Forms

Deposit concrete placed in forms in horizontal layers not exceeding 24 inches.

Remove temporary spreaders in forms when concrete placing has reached elevation of spreaders.

Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Design vibrators to operate with vibratory element submerged in concrete and maintain a speed of not less than 9,000 impulses per minute when submerged in concrete. Provide vibrating equipment adequate in number of units and power of each unit to properly consolidate concrete. Vibration of forms and reinforcement is not be permitted. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced points not farther apart than visible effectiveness of machine. Do not insert vibrator into lower courses of concrete that have

begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of concrete mix.

Do not start placing of concrete in supporting elements until concrete previously placed in columns and walls is no longer plastic and has been in place a minimum of 2 hours.

3.8.10 Placing Concrete Slabs

Place and consolidate concrete for slabs in a continuous operation, within the limits of approved construction joints until placing of panel or section is completed.

During concrete placing operations, consolidate concrete by mechanical vibrating equipment so that concrete is worked around reinforcement and other embedded items and into corners. Consolidate concrete placed in beams and girders of supported slabs and against bulkheads of slabs on ground by mechanical vibrators as specified. Consolidate concrete in remainder of slabs by vibrating bridge screeds, roller pipe screeds, or other approved method. Limit consolidation operations to time necessary to obtain consolidation of concrete without bringing an excess of fine aggregate to the surface. Concrete to be consolidated must be as dry as practical and surfaces thereof must not be manipulated prior to finishing operations. Bring concrete correct level with a straightedge and struck-off. Use bull floats or darbies to smooth surface, leaving it free of humps or hollows. Sprinkling of water on plastic surface is not permitted.

Provide finish of slabs as specified.

3.8.11 Bonding

Surfaces of set concrete at joints, except where bonding is obtained by use of concrete bonding agent, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.

At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.

Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

Bonding of fresh concrete to concrete that has set may be obtained by use of a concrete bonding agent. Apply such bonding material to cleaned concrete surface in accordance with approved printed instructions of bonding material manufacturer.

3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.9.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete must not vary more than the allowable tolerances of ACI/MCP-4. Exposed surfaces must be uniform in appearance and finished to a smooth form finish unless otherwise specified.

3.9.2 Formed Surfaces

3.9.2.1 Tolerances

ACI/MCP-1 and as indicated.

3.9.2.2 As-Cast Rough Form

Provide for surfaces not exposed to public view. Patch these holes and defects and level abrupt irregularities. Remove or rub off fins and other projections exceeding 0.25 inch in height.

3.9.2.3 Standard Smooth Finish

Finish must be as-cast concrete surface as obtained with form facing material for standard smooth finish. Repair and patch defective areas as specified; and all fins and remove other projections on surface.

3.9.3 Mat Footing Finish

Provide concrete indicated with a floated finish as follows:

3.9.4 Surface Finish Samples

Provide a minimum of three sample concrete panels for each finish for each mix design, 3 by 3 feet, 3 inches thick. Use the approved concrete mix design(s). Provide sample panels on-site at locations directed. Once approved, each set of panels must be representative of each of the finishes specified and of the workmanship and finish(es) required. Do not remove or destroy samples until directed by the COR.

3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI/MCP-2, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Where straightedge measurements are specified, Contractor must provide straightedge.

3.10.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.10.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance as defined below,roughen the surface with stiff brushes of rakes before final set.

3.10.1.2 Floated

Use for HVAC, electrical equipment pads, and exterior slabs where not otherwise specified. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float must begin when the surface has stiffened sufficiently to permit the operation. During or after the first floating, check surface with a 10 foot straightedge applied at no less than two different angles, one of which is perpendicular to the direction of strike off. Cut down high spots and fill low spots during this procedure to produce a surface level within 1/4 inch in 10 feet.

3.10.1.3 Steel Troweled

Use for floors scheduled to receive a floor covering. First, provide a floated finish. Next, the finish must be power troweled two times, and finally hand troweled. The first troweling after floating needs to produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Perform additional trowelings done by hand after the surface has hardened sufficiently. The final troweling is done when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate the surface by the hand troweling operations. The finished surface must be essentially free of trowel marks and uniform in texture and appearance. The finished surface must produce a surface level to within 1/4 inch in 10 feet. On surfaces intended to support floor coverings, remove any defects of sufficient magnitude to show through the floor covering by grinding.

3.10.1.4 Broomed

Use on surfaces of exterior mat slab walks, platforms, patios, and ramps, unless otherwise indicated. Perform a floated finish, then draw a broom or burlap belt across the surface to produce a coarse scored texture. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.10.1.5 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a

straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by a burlap drag. Drag a strip of clean, wet burlap from 3 to 10 feet wide and 2 feet longer than the pavement width across the slab. Produce a fine, granular, sandy textured surface without disfiguring marks. Round edges and joints with an edger having a radius of 1/8 inch.

3.10.1.6 Concrete Toppings Placement

The following requirements apply to the placement of toppings of concrete on base slabs that are either freshly placed and still plastic, or on hardened base slabs.

a. Placing on a Fresh Base: Screed and bull float the base slab. As soon as the water sheen has disappeared, lightly rake the surface of the base slab with a stiff bristle broom to produce a bonding surface for the topping. Immediately spread the topping mixture evenly over the roughened base before final set takes place. Give the topping the finish specified herein.

b. Bonding to a Hardened Base: When the topping is to be bonded to a floated or troweled hardened base, roughen the base by scarifying, grit-blasting, scabbling, planing, flame cleaning, or acid-etching to lightly expose aggregate and provide a bonding surface. Remove dirt, laitance, and loose aggregate by means of a stiff wire broom. Keep the clean base wet for a period of 12 hours preceding the application of the topping. Remove excess water and apply a 1:1:1/2 cement-sand-water grout, and brush into the surface of the base slab. Do not allow the cement grout to dry, and spread it only short distances ahead of the topping placement. Do not allow the temperature differential between the completed base and the topping mixture to exceed 41 degrees F at the time of placing. Place the topping and finish as indicated.

3.10.2 Flat Floor Finishes

3.10.3 Concrete Walks

Provide 4 inches thick minimum. Provide contraction joints spaced every 5 linear feet unless otherwise indicated. Cut contraction joints one inch deep with a jointing tool after the surface has been finished. Provide 0.5 inch thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 50 feet maximum. Give walks a broomed finish. Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 1/4 inch in 5 feet.

3.10.4 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.10.5 Curbs and Gutters

Provide contraction joints spaced every 10 feet maximum unless otherwise indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum unless otherwise indicated. Perform pavement finish.

3.10.6 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks may be precast concrete, and must be 24 inches long, 12 inches wide and 4 inches thick, unless otherwise indicated, with smooth-finished countersunk dishes sloped to drain away from the building.

3.11 CURING AND PROTECTION

ACI/MCP-2 unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs.

3.11.1 General

Protect freshly placed concrete from premature drying and cold or hot temperature and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of cement and proper hardening of concrete.

Start initial curing as soon as free water has disappeared from surface of concrete after placing and finishing. Keep concrete moist for minimum 72 hours.

Final curing must immediately follow initial curing and before concrete has dried. Continue final curing until cumulative number of hours or fraction thereof (not necessarily consecutive) during which temperature of air in contact with the concrete is above 50 degrees F has totaled 168 hours. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, final curing may be terminated when the average compressive strength has reached 70 percent of the 28-day design compressive strength. Prevent rapid drying at end of final curing period.

3.11.2 Moist Curing

Remove water without erosion or damage to the structure. Prevent water run-off.

3.11.2.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water must not be more than 50 degrees F less than the temperature of the concrete. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.11.2.2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.11.2.3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Provide sheeting that is at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.11.2.4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.11.3 Liquid Membrane-Forming Curing Compound

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of Figure 2.1.5 in ACI/MCP-2 indicates that hot weather conditions cause an evaporation rate exceeding 0.2 pound of water per square foot per hour.

3.11.3.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats must be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound must form a uniform, continuous, coherent film that does not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Re-spray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.11.3.2 Protection of Treated Surfaces

Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.11.4 Liquid Chemical Sealer-Hardener

Apply sealer-hardener to interior floors not receiving floor covering and floors located under access flooring. Apply the sealer-hardener in accordance with manufacturer's recommendations. Seal or cover joints and openings in which joint sealant is to be applied as required by the joint sealant manufacturer. Do not apply the sealer hardener until the concrete has been moist cured and has aged for a minimum of 30 days. Apply a minimum of two coats of sealer-hardener.

3.11.5 Requirements for Type III, High-Early-Strength Portland Cement

The curing periods are required to be not less than one-fourth of those specified for portland cement, but in no case less than 72 hours.

3.11.6 Curing Periods

ACI/MCP-2 except 10 days for retaining walls, pavement or chimneys, 21 days for concrete that is in full-time or intermittent contact with seawater, salt spray, alkali soil or waters. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the COR.

3.11.7 Curing Methods

Accomplish curing by moist curing, by moisture-retaining cover curing, by membrane curing, and by combinations thereof, as specified.

Moist curing:

Accomplish moisture curing by any of the following methods:

Keeping surface of concrete wet by covering with water

Continuous water spraying

Covering concrete surface with specified absorptive cover for curing concrete saturated with water and keeping absorptive cover wet by water spraying or intermittent hosing. Place absorptive cover to provide coverage of concrete surfaces and edges with a slight overlap over adjacent absorptive covers.

Moisture-cover curing:

Accomplish moisture-retaining cover curing by covering concrete surfaces with specified moisture-retaining cover for curing concrete. Place cover directly on concrete in widest practical width, with sides and ends lapped at least 3 inches. Weight cover to prevent displacement; immediately repair tears or holes appearing during curing period by patching with pressure-sensitive, waterproof tape or other approved method.

Membrane curing:

Accomplish membrane curing by applying specified membrane-forming curing compound to damp concrete surfaces as soon as moisture film has

disappeared. Apply curing compound uniformly in a two-coat operation by power-spraying equipment using a spray nozzle equipped with a wind guard. Apply second coat in a direction at right angles to direction of first coat. Total coverage for two coats must be not more than 200 square feet per gallon of curing compound. Respray concrete surfaces which are subjected to heavy rainfall within 3 hours after curing compound has been applied by method and at rate specified. Maintain continuity of coating for entire curing period and immediately repair damage to coating during this period.

Membrane-curing compounds must not be used on surfaces that are to be covered with coating material applied directly to concrete or with a covering material bonded to concrete, such as other concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, painting, and other coatings and finish materials.

3.11.8 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

3.11.9 Curing Unformed Surfaces

Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.

Unless otherwise specified, accomplish final curing of unformed surfaces by any of curing methods specified above, as applicable.

Accomplish final curing of concrete surfaces to receive liquid floor hardener of finish flooring by moisture-retaining cover curing.

3.11.10 Temperature of Concrete During Curing

When temperature of atmosphere is 41 degrees F and below, maintain temperature of concrete at not less than 55 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 37 degrees F in any 1 hour nor 80 degrees F in any 24-hour period.

3.11.11 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive

vibration and from damage caused by rain or running water.

3.11.12 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.12 FIELD QUALITY CONTROL

3.12.1 Sampling

ASTM C172/C172M. Collect samples of fresh concrete to perform tests specified. ASTM C 31/C 31M for making test specimens.

3.12.2 Testing

3.12.2.1 Slump Tests

ASTM C 143/C 143M. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

3.12.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.12.2.3 Compressive Strength Tests

ASTM C 39/C 39M. Make five test cylinders for each set of tests in accordance with ASTM C 31/C 31M. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Take samples for strength tests of each mix design of concrete placed each day not less than once a day, nor less than once for each 160 cubic yards of concrete, nor less than once for each 5400 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 450 psi, take a minimum of three ASTM C 42/C 42M core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test is considered structurally adequate if the average of three cores is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c. Retest locations represented by erratic core strengths. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.12.2.4 Air Content

ASTM C 173/C 173M or ASTM C231/C231M for normal weight concrete. Test

air-entrained concrete for air content at the same frequency as specified for slump tests.

3.12.2.5 Strength of Concrete Structure

Compliance with the following is considered deficient if it fails to meet the requirements which control strength of structure in place, including following conditions:

Failure to meet compressive strength tests as evaluated

Reinforcement not conforming to requirements specified

Concrete which differs from required dimensions or location in such a manner as to reduce strength

Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified

Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration

Poor workmanship likely to result in deficient strength

3.12.2.6 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements, make cores drilled from hardened concrete for compressive strength determination in accordance with ASTM C 42/C 42M, and as follows:

Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the COR.

Test cores after moisture conditioning in accordance with ASTM C 42/C 42M if concrete they represent is more than superficially wet under service.

Air dry cores, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.

Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

Core specimens will be taken and tested by the Government. If the results of core-boring tests indicate that the concrete as placed does not conform to the drawings and specification, the cost of such tests and restoration required must be borne by the Contractor.

Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the COR.

3.13 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows.

3.13.1 Mixing Equipment

Before concrete pours, designate Company-owned site meeting environmental standards or on-site area to be paved later in project for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.13.2 Hardened, Cured Waste Concrete

Crush and reuse hardened, cured waste concrete as fill or as a base course for pavement. Use hardened, cured waste concrete as aggregate in concrete mix if approved by COR.

3.13.3 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.13.4 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material. Return excess cement to supplier. Institute deconstruction and construction waste separation and recycling for use in manufacturer's programs. When such a program is not available, seek local recyclers to reclaim the materials.

3.14 JOINTS

3.14.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Locate construction joints as follows:

a. In walls at not more than 60 feet in any horizontal direction; at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall

b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier

c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

d. In slabs on ground, so as to divide slab into areas not in excess of 1,200 square feet

Provide keyways at least 1-1/2-inches deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used

for slabs.

Joints must be perpendicular to main reinforcement. Reinforcement must be continued across construction joints.

3.14.2 Waterstops

Provide waterstops in construction joints as indicated.

Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Make field joints in waterstops in accordance with waterstop manufacturer's printed instructions, as approved. Protect waterstops protruding from joints from damage.

3.15 INSTALLATION OF ANCHORAGE DEVICES

3.15.1 General

Anchorage devices and embedded items required for other work that is attached to, or supported by, set and build in cast-in-place concrete as part of the work of this section, using setting drawings, instructions, and directions for work to be attached thereto.

3.15.2 Placing Anchorage Devices

Anchorage devices and embedded items must be positioned accurately and supported against displacement. Fill openings in anchorage devices such as slots and threaded holes with an approved, removable material to prevent entry of concrete into openings.

3.16 CONCRETE CONVEYING

3.16.1 Transfer of Concrete At Project Site

Handle concrete from point of delivery and transfer to concrete conveying equipment and to locations of final deposit as rapidly as practical by methods which prevent segregation and loss of concrete mix materials.

3.16.2 Mechanical Equipment for Conveying Concrete

Equipment must ensure a continuous flow of concrete at delivery end, as approved. Provide runways for wheeled concrete-conveying equipment from concrete delivery point to locations of final deposit. Interior surfaces of concrete conveying equipment must be free of hardened concrete, debris, water, snow, ice, and other deleterious substances.

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SECTION 05 12 00

STRUCTURAL STEEL

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for structural steel used in building construction.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 201	AISC Certification Program for Structural Steel Fabricators
AISC 303	Code of Standard Practice for Steel Buildings and Bridges
AISC 325	Steel Construction Manual
AISC 326	Detailing for Steel Construction
AISC 810	Design Guide 10: Erection Bracing of Low-Rise Structural Steel Buildings
ANSI/AISC 341	Seismic Provisions for Structural Steel Buildings
ANSI/AISC 360	Specification for Structural Steel Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B46.1	Surface Texture, Surface Roughness, Waviness and Lay

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143/A143M	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A325M	Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A500/A500M	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A572/A572M	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A6/A6M	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	Standard Specification for Structural Steel Shapes
ASTM C 1107/C 1107M	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C827/C827M	Change in Height at Early Ages of

	Cylindrical Specimens from Cementitious Mixtures
ASTM F 1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F 436	Hardened Steel Washers
ASTM F 844	Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959	Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3	Commercial Blast Cleaning

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.756	Steel Erection; Beams and Columns

1.3 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer galvanizing, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with ANSI/AISC 360 and ANSI/AISC 341 except as modified in this contract.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Erection Plan, including description of temporary supports

Fabrication drawings including description of connections

SD-03 Product Data

Shop primer (also coordinate with Section 09 90 00)

Welding electrodes and rods

Load indicator washers

Non-Shrink Grout

Load indicator bolts

Include test report for Class B primer.

SD-06 Test Reports

Class B coating

Bolts, nuts, and washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

SD-07 Certificates

Steel

Bolts, nuts, and washers

Galvanizing (also coordinate with Section 09 90 00)

AISC Quality Certification

Welding procedures and qualifications

1.5 AISC QUALITY CERTIFICATION

Work shall be fabricated in an AISC certified Category Stdfabrication plant.

1.6 SEISMIC PROVISIONS

The structural steel system shall be provided in accordance with ANSI/AISC 341.

1.7 QUALITY ASSURANCE

1.7.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326 and AISC 325. Fabrication drawings shall not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Double connections that require an erection seat to comply with OSHA 29 CFR 1926.756(c)(1) shall be shown on the shop drawings, reviewed and approved by the structural engineer of record. Use AWS A2.4 standard welding symbols. Shoring and temporary bracing shall be designed and sealed by a registered professional engineer licensed in the State of California and submitted for record purposes as part of the drawings. Member substitutions of details shown on the contract drawings shall be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.7.2 Certifications

1.7.2.1 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing.

1.7.2.2 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified

under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

ASTM A36/A36M.

2.1.2 High-Strength Structural Steel

2.1.2.1 Low-Alloy Steel

ASTM A572/A572M, Grade 50. ASTM A992/A992M Grade 50.

2.1.3 Structural Shapes for Use in Building Framing

Wide flange shapes, ASTM A992/A992M.

2.1.4 Structural Steel Tubing

ASTM A500/A500M, Grade B.

2.1.5 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B, weight class STD (Standard).

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Structural Steel, Steel Pipe

2.2.1.1 Bolts

ASTM A307, Grade A; ASTM A325, Type 1. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.1.2 Nuts

ASTM A563, Grade and Style for applicable ASTM bolt standard recommended.

2.2.1.3 Washers

ASTM F 844 washers for ASTM A307 bolts, and ASTM F 436 washers for ASTM A325 bolts.

2.2.2 High-Strength Structural Steel and Structural Steel Tubing

2.2.2.1 Bolts

ASTM A325, Type 1.

2.2.2.2 Nuts

ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

2.2.2.3 Washers

ASTM F 436, plain carbon steel.

2.2.3 Foundation Anchorage

2.2.3.1 Anchor Bolts

ASTM F 1554.

2.2.3.2 Anchor Nuts

ASTM A563, Grade A, hex style.

2.2.3.3 Anchor Washers

ASTM F 844.

2.2.3.4 Anchor Plate Washers

ASTM A36/A36M.

2.2.4 Load Indicator Washers

ASTM F 959.

2.2.5 Load Indicator Bolts

ASTM A325, Type 1; with a manufactured notch between the bolt tip and threads. The bolt shall be designed to react to the opposing rotational torques applied by the installation wrench, with the bolt tip automatically shearing off when the proper tension is obtained.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.

2.3.2 Non-Shrink Grout

ASTM C 1107/C 1107M, with no ASTM C827/C827M shrinkage. Grout shall be nonmetallic.

2.3.3 Welded Shear Stud Connectors

AWS D1.1/D1.1M.

2.4 SHOP PRIMER

Shop prime structural steel -- see Section 09 90 00. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

2.5 GALVANIZING

ASTM A123/A123M or ASTM A153/A153M, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

2.6.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

2.6.2 Shop Primer

Shop prime structural steel per Section 09 90 00, except as modified herein. Do not prime steel surfaces embedded in concrete, galvanized surfaces, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the COR.

2.6.2.1 Cleaning

SSPC SP 6/NACE No.3. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.6.2.2 Primer

Apply primer to a minimum dry film thickness of 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

2.6.3 Epoxy Coated Surfaces

Surfaces to receive epoxy coatings shall be cleaned and prepared in accordance with the manufacturer's recommendations.

2.7 DRAINAGE HOLES

Adequate drainage holes shall be drilled to eliminate water traps. Hole diameter shall be 1/2 inch and location shall be indicated on the detail drawings. Hole size and location shall not affect the structural integrity.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC 325. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC 201 for Category conventional steel building structures structural steelwork.

Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A6/A6M.

Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with endorsement "P" of AISC 201 and primed with the specified paint.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the COR.

3.2 ERECTION

For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), the erection plan shall conform to AISC 303 and the structure shall be erected in accordance withAISC 810.

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.2.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.3 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with ANSI/AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member. Holes shall not be cut or enlarged by burning. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.3.1 Common Grade Bolts

ASTM A307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the COR for further instructions.

3.3.2 High-Strength Bolts

Provide load indicator bolts or washers in all ASTM A325M bolted connections, except provide only load indicator washers for slip critical connections. Direct tension indicator tightening, shall be the only acceptable tightening methods. Use only direct tension indicator tightening for slip critical connections. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.3.2.1 Installation of Load Indicator Washers (LIW)

ASTM F 959. Where possible, the LIW shall be installed under the bolt head and the nut shall be tightened. If the LIW is installed adjacent to the turned element, provide a flat ASTM F 436 washer between the LIW and nut when the nut is turned for tightening, and between the LIW and bolt head when the bolt head is turned for tightening.

3.4 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the COR.

3.5 WELDING

AWS D1.1/D1.1M Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

The Contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

3.5.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas.

3.6 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.6.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.7 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A780/A780M

zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.8 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing, except that electric power for field tests will be furnished as set forth in Division 1. The COR shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.8.1 Welds

3.8.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

3.8.1.2 Nondestructive Testing

AWS D1.1/D1.1M. Test locations shall be selected by the COR. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the COR. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

Testing frequency: Provide the following types and number of tests:

Test Type	Number of Tests
Radiographic (complete penetration welds)	100%
Ultrasonic (complete penetration welds)	100%
Magnetic Particle (fillet welds)	25%
Dye Penetrant (fillet welds)	25%

3.8.2 Load Indicator Washers

3.8.2.1 Load Indicator Washer Compression

Load indicator washers shall be tested in place to verify that they have been compressed sufficiently to provide the 0.015 inch gap when the load indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.005 inch gap when the load indicator washer is placed under the turned element, as required by ASTM F 959.

3.8.3 High-Strength Bolts

3.8.3.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill

certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in ANSI/AISC 360, depending on bolt size and grade. The bolt tension shall be developed by tightening the nut. A representative of the manufacturer or supplier shall be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements.

3.8.3.2 Inspection

Inspection procedures shall be in accordance with ANSI/AISC 360. Confirm and report to the COR that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

Inspection by the Government will include proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use; and calibration of torque wrenches for high-strength bolts.

The Contractor shall inspect proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use; and calibration of torque wrenches for high-strength bolts.

3.8.3.3 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the COR. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested. Retest new bolts after installation.

3.8.4 Testing for Embrittlement

ASTM A143/A143M for steel products hot-dip galvanized after fabrication.

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-- End of Section Table of Contents --

SECTION 05 30 00

STEEL DECKS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for steel floor and roof decks, including accessories.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI D100	Cold-Formed Steel Design Manual
AISI SG03-3	Cold-Formed Steel Design Manual Set

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel
AWS D1.3/D1.3M	Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

FM GLOBAL (FM)

FM APP GUIDE	Approval Guide

http://www.approvalguide.com/

FM DS 1-28	Design Wind Loads

STEEL DECK INSTITUTE (SDI)

SDI 31	Design Manual for Composite Decks, Form Decks, and Roof Decks
SDI DDMO3	Diaphragm Design Manual; 3rd Edition
SDI DDP	Deck Damage and Penetrations
SDI MOC2	Manual of Construction with Steel Deck

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	Structural Engineering

UNDERWRITERS LABORATORIES (UL)

UL 209	Cellular Metal Floor Raceways and Fittings
UL 580	Tests for Uplift Resistance of Roof Assemblies
UL Bld Mat Dir	Building Materials Directory

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings

Metal Roof Deck Units

Metal Closure Strips

SD-03 Product Data

Accessories

Deck Units

Galvanizing Repair Paint

Joint Sealant Material

Metal Roor Deck Units

Repair Paint

Welder Qualifications

Welding Equipment

Welding Rods and Accessories

SD-04 Samples

Metal Roof Deck Units

Flexible Closure Strips

SD-05 Design Data

Deck Units

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

SD-07 Certificates

. Welding Procedures

Fire Safety

Wind Storm Resistance

1.4 QUALITY ASSURANCE

1.4.1 Deck Units

Furnish deck units and accessory products from a manufacturer regularly engaged in manufacture of steel decking. Provide manufacturer's certificates attesting that the decking material meets the specified requirements.

1.4.2 Qualifications for Welding Work

Follows Welding Procedures in accordance with AWS D1.1/D1.1M. Test specimens shall be made in the presence of COR and shall be tested by an approved testing laboratory at the Contractor's expense.

Submit qualified Welder Qualifications in accordance with AWS D1.1/D1.1M, or under an equivalent approved qualification test. Perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, perform an immediate retest of two test welds until each test weld passes. Failure in the immediate retest will require the welder be retested after further practice or training, performing a complete set of test welds.

Submit manufacturer's catalog data for Welding Equipment and Welding Rods and Accessories.

1.4.3 Regulatory Requirements

1.4.3.1 Fire Safety

Test roof deck as a part of a roof deck construction assembly of the type used for this project, listing as fire classified in the UL Bld Mat Dir, or listing as Class I construction in the FM APP GUIDE, and so labeled.

1.4.3.2 Wind Storm Resistance

Provide roof construction assembly capable of withstanding an uplift pressure of 60 pounds per square foot when tested in accordance with the uplift pressure test described in the FM DS 1-28 or as described in UL 580 and in general compliance with UFC 3-301-01.

1.4.4 Fabrication Drawings

Show type and location of units, location and sequence of connections, bearing on supports, methods of anchoring, attachment of accessories, adjusting plate details, size and location of holes to be cut and reinforcement to be provided, the manufacturer's erection instructions and other pertinent details.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver deck units to the site in a dry and undamaged condition. Store and handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Do not use decking for storage or as working platform until units have been fastened into position. Exercise care not to damage material or overload decking during construction. Must not exceed the design live load. The maximum uniform distributed storage load. Stack decking on platforms or pallets and cover with weathertight ventilated covering. Elevate one end during storage to provide drainage. Maintain deck finish at all times to prevent formation of rust. Repair deck finish using touch-up paint. Replace damaged material.

1.6 DESIGN REQUIREMENTS FOR ROOF DECKS

1.6.1 Properties of Sections

Properties of metal roof deck sections must comply with engineering design width as limited by the provisions of AISI D100.

1.6.2 Allowable Loads

Indicate total uniform dead and live load for detailing purposes.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Sheet

Flat rolled carbon steel sheets of structural quality, thickness not less than indicated on the drawings before coating, meeting the requirements of AISI SG03-3, except as modified herein.

2.1.2 Steel Coating

ASTM A653/A653M designation Z275, G90 galvanized. Apply coating to both sides of sheet. Conform to UL 209 for coating on decking provided as wire raceways.

2.1.3 Galvanized Steel Angles for Roof Decks

Provide hot-rolled carbon steel angles conforming to ASTM A36/A36M, merchant quality, Grade Designation SAE/AISI 1023 or SAE/AISI 1025, and

hot-dip galvanized in accordance with ASTM A123/A123M.

2.1.4 Joint Sealant Material for Roof Decks

Provide a nonskinning, gun-grade, bulk compound material as recommended by the manufacturer.

2.1.5 Galvanizing Repair Paint for Roof Decks

Provide a high zinc-dust content paint for regalvanizing welds in galvanized steel and shall conform to ASTM A780/A780M.

2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

2.2.1 Adjusting Plates

Provide adjusting plates, or segments of deck units, of same thickness and configuration as deck units in locations too narrow to accommodate full size units. Provide factory cut plates of predetermined size where possible.

2.2.2 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 0.028 inch thick to close open ends at eaves and openings through deck.

2.2.3 Sheet Metal Collar

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.2.4 Cover Plates

Sheet metal to close panel edge and end conditions, and where panels change direction or butt. Polyethylene-coated, self-adhesive, 2 inch wide joint tape may be provided in lieu of cover plates on flat-surfaced decking butt joints.

2.2.5 Roof Sump Pans

Sump pans must be provided for roof drains and must be minimum 0.075 inch thick steel, flat or recessed type. Shape sump pans to meet roof slope by the supplier or by a sheet metal specialist. Provide bearing flanges of sump pans to overlap steel deck a minimum of 3 inch. Shape, size, and reinforce the opening in bottom of the sump pan to receive roof drain.

2.2.6 Column Closures

Sheet metal, minimum 0.0358 inch thick or metal rib lath.

2.2.7 Access Hole Covers

Sheet metal, minimum 0.0474 inch thick.

2.2.8 Miscellaneous Accessories

Furnish the manufacturer's standard accessories to complete the deck installation. Furnish metal accessories of the same material as the deck and with the minimum design thickness as follows: saddles, 0.0474 inch welding washers, 0.0598 inch cant strip, 0.0295 inch other metal accessories, 0.0358 inch unless otherwise indicated. Accessories must include but not be limited to saddles, welding washers, fasteners, cant strips, butt cover plates, underlapping sleeves, and ridge and valley plates.

2.3 FABRICATION

Furnish sample of Metal Roof Deck Units used to illustrate actual cross section dimensions and configurations.

2.3.1 Roof Deck

Fabricate roof deck units of the steel design thickness required by the design drawings and galvanized zinc-coated in conformance with ASTM A653/A653M, G90 coating class.

2.3.1.1 Metal Closure Strips for Roof Decks

Fabricate strips from the specified commercial-quality steel sheets not less than nominal 0.0359 inch thick before galvanizing. Provide strips from the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

3.2 INSTALLATION

Install steel deck units in accordance with SDI DDMO3 and approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports before permanently securing in place. Damaged deck and accessories including material which is permanently stained or contaminated, deformed, or with burned holes shall not be installed. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the COR and make necessary corrections before permanently anchoring deck units. Locate deck ends over supports only. Do not use unanchored deck units as a work or storage platform. Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck unless indicated. Distribute loads by appropriate means to prevent damage.

3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units by welding with normal5/8 inch diameter puddle welds or fastened with screws, as indicated on the design drawings and in

accordance with manufacturer's recommended procedure and SDI 31. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding or fastening.

3.2.1.1 Welding

Perform welding in accordance with AWS D1.3/D1.3M using methods and electrodes recommended by the manufacturers of the base metal alloys being used. Ensure only operators previously qualified by tests prescribed in AWS D1.1/D1.1M and AWS D1.3/D1.3M make welds. Immediately recertify, or replace qualified welders, that are producing unsatisfactory welding. Do not use welding washers at the connections of the deck to supports. Do not use welding washers at sidelaps. Holes and similar defects will not be acceptable. Lap 2 inch deck ends. Attach all partial or segments of deck units to structural supports in accordance with Section 2.5 of SDI DDMO3. Immediately clean welds by chipping and wire brushing. Heavily coat welds, cut edges and damaged portions of coated finish with zinc-dust paint conforming to ASTM A780/A780M finish with the manufacturer's standard touch-up paint.

3.2.2 Openings

Cut or drill all holes and openings required and be coordinated with the drawings, specifications, and other trades. Frame and reinforce openings through the deck in conformance with SDI DDP. Reinforce holes and openings 6 to 12 inch across by 0.0474 inch thick steel sheet at least 12 inch wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 6 inch on center. Reinforce holes and openings larger than 12 inch by steel channels or angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Install steel channels or angles perpendicular to the deck ribs and fasten to the channels or angles perpendicular to the steel joists. Deck manufacturer shall approve holes or openings larger than 6 inch in diameter prior to drilling or cutting. Openings must not interfere with seismic members such as chords and drag struts.

3.2.3 Deck Damage

SDI MOC2, for repair of deck damage.

3.2.4 Accessory Installation

3.2.4.1 Adjusting Plates

Provide in locations too narrow to accommodate full-size deck units and install as shown on shop drawings.

3.2.4.2 End Closures

Provide end closure to close open ends of cells at columns, walls, and openings in deck.

3.2.4.3 Access Hole Covers

Provide to seal holes cut in decking to facilitate welding of decking to structural supports.

3.3 JOINT SEALING FOR ROOF DECKS

Seal sidelaps and endlaps with manufacturer's recommended joint sealing material. Shop or field apply the material. Before applying the sealing material, completely remove dust, dirt, moisture, and other foreign material from the surfaces to which the sealing material is to be applied. Apply sealing material in strict accordance with the sealing material manufacturer's printed instructions.

3.4 ROOF SUMP PANS

Place sump pans over openings in roof decking and fusion welded to top surface of roof decking. Do not exceed spacing of welds of 12 inch with not less than one weld at each corner. Field cut opening in the bottom of each roof sump pan to receive the roof drain as part of the work of this section.

3.5 CANT STRIPS FOR ROOF DECKS

Provide strips to be fusion welded to surface of roof decking, secured to wood nailers by galvanized screws or to steel framing by galvanized self-tapping screws or welds. Do not exceed spacing of welds and fasteners of 12 inch. Lap end joints a minimum 3 inch and secure with galvanized sheet metal screws spaced a maximum 4 inch on center.

3.6 RIDGE AND VALLEY PLATES FOR ROOF DECKS

Provide plates to be fusion welded to top surface of roof decking. Lap end joints a minimum 3 inch. For valley plates, provide endlaps to be in the direction of water flow.

3.7 CLOSURE STRIPS FOR ROOF DECKS

Provide closure strips at open, uncovered ends and edges of the roof decking and in voids between roof decking and top of walls and partitions where indicated. Install closure strips in position in a manner to provide a weathertight installation.

3.8 CLEANING AND PROTECTION FOR ROOF DECKS

Upon completion of the deck, sweep surfaces clean and prepare for installation of the roofing.

3.9 FIELD QUALITY CONTROL

3.9.1 Decks Not Receiving Concrete

Inspect the decking top surface for distortion after installation. For roof decks not receiving concrete, verify distortion by placing a straight edge across three adjacent top flanges. The maximum allowable gap between the straight edge and the top flanges is 1/16 inch; when gap is more than 1/16 inch, provide corrective measures or replacement. Reinspect decking after performing corrective measures or replacement.

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SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for miscellaneous metalwork.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.3	Operations - Safety Requirements for Powder Actuated Fastening Systems

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	Standard for Square and Hex Nuts
ASME B18.21.1	Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.6.2	Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series
ASME B18.6.3	Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A47/A47M	Standard Specification for Ferritic Malleable Iron Castings
ASTM A500/A500M	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A924/A924M	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C 1513	Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM D 1187	Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E 488	Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	Alkyd Anti-Corrosive Metal Primer

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	Metal Bar Grating Manual

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Floor gratings, installation drawings

SD-03 Product Data

Floor gratings

SD-04 Samples

Floor grating; G

Provide 12 inch x 12 inch size samples, taken from manufacturer's stock, and be complete as required for installation in the structure.

1.4 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.5 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A36/A36M.

2.1.2 Structural Tubing

ASTM A500/A500M.

2.1.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B.

2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A47/A47M.

2.1.5 Floor Gratings

c. Metal bar type grating NAAMM MBG 531.

2.1.6 Anchor Bolts

ASTM A307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.6.1 Expansion and Adhesive Anchors

Provide expansion anchors and adhesive anchors. Minimum concrete embedment and diameter shall be as indicated. Design values listed shall be as tested according to ASTM E 488.

a. Minimum allowable pullout value shall be per ICC-ESR Report.

b. Minimum allowable shear value shall be per ICC-ESR Report.

2.1.6.2 Lag Screws and Bolts

ASME B18.2.1, type and grade best suited for the purpose.

2.1.6.3 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 or ASTM A307.

2.1.6.4 Powder Actuated Fasteners

Follow safety provisions of ASSE/SAFE A10.3.

2.1.6.5 Screws

ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C 1513.

2.1.6.6 Washers

Provide plain washers to conform to ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.1.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, G90, as applicable.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by COR. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.3 FLOOR GRATINGS

Design steel grating in accordance with NAAMM MBG 531 for bar type grating or manufacturer's charts for plank grating. Galvanize steel floor gratings.

a. Design floor gratings to support a live load of 60 pounds per square foot for the spans indicated, with maximum deflection of L/240.

b. NAAMM MBG 531, band edges of grating with bars of the same size as the bearing bars. Weld banding in accordance with the manufacturer's standard for trim unless otherwise indicated. Design tops of bearing

bars, cross or intermediate bars to be in the same plane and match grating finish.

c. Anchor gratings to structural members with saddle clips.

d. Slip resistance requirements must exceed both wet and dry a static coefficient of friction of 0.5.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners shall be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Form joints exposed to the weather shall be formed to exclude water. Items listed below require additional procedures.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections of work in place and grind smooth. Provide a smooth finish on exposed surfaces of work in place and unless otherwise approved, flush exposed riveting. Mill joints where tight fits are required. Corner joints shall be coped or mitered, well formed, and in true alignment. Accurately set work to established lines and elevations and securely fastened in place. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 BUILT-IN WORK

Form for anchorage metal work built-in with concrete or masonry, or provide with suitable anchoring devices as indicated or as required. Furnish metal work in ample time for securing in place as the work progresses.

3.5 WELDING

Perform welding, welding inspection, and corrective welding, in accordance

with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.6 FINISHES

3.6.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a anti-corrosive metal alkyd primer similar to MPI 79 with a VOC content of less than 250 g/L, to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

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SECTION 05 51 00

METAL STAIRS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for steel stair systems which are not a part of any other metals system of the specification.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

ANSI/AISC 360	Specification for Structural Steel Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.21.1	Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A283/A283M	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A36/A36M	Standard Specification for Carbon Structural Steel

ASTM A500/A500M	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A6/A6M	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924/A924M	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	Metal Bar Grating Manual

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit fabrication drawings for the following items in accordance with the paragraph entitled, "General Requirements," of this section.

Iron and Steel Hardware

Steel Shapes, Plates, Bars and Strips

Metal Stair System

SD-07 Certificates

Submit Welding Procedures in accordance with AWS D1.1/D1.1M.

Submit certificates for Welder Qualification in accordance with the paragraph entitled, "Qualifications for Welding Work," of this section.

SD-08 Manufacturer's Instructions

Submit manufacturer's installation instructions for the following products used in the fabrication of steel stair work.

1.4 QUALIFICATIONS FOR WELDING WORK

Welder Qualification. Prior to welding, submit certification for each

welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification test. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he or she has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Submit welding procedures in accordance with AWS D1.1/D1.1M. Make test specimens in the presence of the COR and test by an approved testing laboratory at the Contractor's expense.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

Submit complete and detailed fabrication drawings for all iron and steel hardware, and for all steel shapes, plates, bars and strips used in accordance with the design specifications referenced in this section.

Pre-assemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and application of surface finishes, including zinc coatings.

2.2 STRUCTURAL STEEL PLATES, SHAPES AND BARS

Structural-size shapes and plates, conforming to ASTM A36/A36M, unless otherwise noted, except bent or cold-formed plates.

Steel plates - bent or cold-formed, conforming to ASTM A283/A283M, Grade C.

Steel bars and bar-size shapes, conforming to ASTM A36/A36M, unless otherwise noted for steel bars and bar-size shapes.

2.3 STRUCTURAL STEEL TUBING

Structural steel tubing, hot-formed, welded or seamless, conforming to ASTM A500/A500M, Grade B, unless otherwise noted.

2.4 GALVANIZED CARBON STEEL SHEETS

Galvanized carbon steel sheets conforming to ASTM A653/A653M, with galvanizing conforming to ASTM A653/A653M and ASTM A924/A924M.

2.5 STEEL PIPE

Steel pipe conforming to ASTM A53/A53M, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

2.6 FASTENERS

Galvanized zinc-coated fasteners in accordance with ASTM A153/A153M and

used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of steel stair items.

Standard/regular hexagon-head bolts and nuts conforming to ASTM A307, Grade A.

Plain washers, round, general-assembly-grade, carbon steel conforming to ASME B18.21.1.

2.7 GENERAL FABRICATION

Prepare and submit metal stair system shop drawings with detailed plans and elevations at not less than 1 inch to 1 foot with details of sections and connections at not less than 3 inches to 1 foot. Also detail placement drawings, diagrams, templates for installation of anchorage, including but not limited to, concrete inserts, anchor bolts, and miscellaneous metal items having integral anchorage devices.

Use materials of size and thicknesses indicated or, if not indicated, of required size and thickness to produce adequate strength and durability in finished product for intended use. Work materials to dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use type of materials indicated or specified for the various components of work.

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch, and bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Continuously weld corners and seams in accordance with the recommendations of AWS D1.1/D1.1M. Grind smooth exposed welds and flush to match and blend with adjoining surfaces.

Form exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use Phillips flathead (countersunk) screws or bolts.

Provide and coordinate anchorage of the type indicated with the supporting structure. Fabricate anchoring devices, space as indicated and required to provide adequate support for the intended use of the work.

Use hot-rolled steel bars for work fabricated from bar stock unless work is indicated or specified as fabricated from cold-finished or cold-rolled stock.

2.8 PROTECTIVE COATING

Hot dip galvanize steelwork as indicated in accordance with ASTM A123/A123M. Touch up abraded surfaces and cut ends of galvanized members with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.

2.9 METAL STAIR SYSTEM

2.9.1 General

Use welding for joining pieces together. Fabricate units so that bolts and

other fastenings do not appear on finish surfaces. Make joints true and tight, and connections between parts lightproof tight. Grind smooth continuous welds where exposed.

Construct metal stair units to sizes and arrangements indicated. Provide framing, hangers, columns, struts, clips, brackets, bearing plates, and other components as required for the support of stairs and platforms.

2.9.2 Stair Framing

Fabricate stringers of structural steel channels, or plates, or a combination thereof as indicated. Provide closures for exposed ends of stringers.

Construct platforms of structural steel channel headers and miscellaneous framing members as required. Bolt headers to stringers and newels and framing members to stringers and headers.

2.9.3 Floor Grating Treads And Platforms

Provide floor grating treads and platforms conforming to ASTM A6/A6M, ASTM A29/A29M and NAAMM MBG 531, "Metal Bar Grating Manual." Provide pattern, spacing, and bar sizes as indicated:

a. Galvanized finish conforming to ASTM A123/A123M.

b. Fabricate grating treads with steel plate nosing on one edge and with steel angle or steel plate carrier at each end for string connections. Secure treads to strings with bolts.

c. Fabricate grating treads with steel plate nosing on one edge and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.

2.9.4 Metal Stair System

Provide steel stairs complete with stringers, grating treads, landings, columns, handrails, and necessary bolts and other fastenings. Hot-dip galvanize steel stairs and accessories.

2.9.4.1 Design Loads

Design stairs to sustain a live load of not less than 100 pounds per square foot, or a concentrated load of 300 pounds per square foot applied where it is most critical. Conform to ANSI/AISC 360 with the design and fabrication of steel stairs, other than a commercial product.

2.9.4.2 Materials

Provide steel stairs of welded construction except that bolts may be used where welding is not practicable. Screw or screw-type connections are not permitted.

a. Structural Steel: ASTM A36/A36M.

b. Gratings for Treads and Landings: NAAMM MBG 531

c. Before fabrication, obtain necessary field measurements and verify drawing dimensions.

d. Clean metal surfaces free from mill scale, flake rust and rust pitting prior to shop finishing. Weld permanent connections. Finish welds flush and smooth on surfaces that will be exposed after installation.

PART 3 EXECUTION

3.1 STEEL STAIRS

Provide anchor bolts, grating fasteners, washers, and all parts or devices necessary for proper installation. Provide lock washers under nuts.

3.2 FIELD WELDING

Execute procedures of manual shielded metal arc welding, appearance and quality of welds made, and methods used in correcting welding work in compliance with AWS D1.1/D1.1M.

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SECTION 05 51 33

METAL LADDERS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for the use of metal ladders.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A47/A47M	Standard Specification for Ferritic Malleable Iron Castings
ASTM A500/A500M	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized

	Coatings
ASTM A924/A924M	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM D 1187	Asphalt-Base Emulsions for Use as Protective Coatings for Metal

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	Alkyd Anti-Corrosive Metal Primer

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.27	Fixed Ladders

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Ladders, installation drawings

SD-03 Product Data

Ladders

1.4 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.5 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A36/A36M.

2.1.2 Structural Tubing

ASTM A500/A500M.

2.1.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B.

2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A47/A47M.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, G90, as applicable.

2.2.2 Galvanize

Anchor bolts, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by COR. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.3 LADDERS

Fabricate vertical ladders conforming to Section 7 of 29 CFR 1910.27. Use 2 1/2 by 3/8 inch steel flats for stringers and 3/4 inch diameter steel rods for rungs. Rungs to be not less than 24 inches wide, spaced one foot apart, plug welded or shouldered and headed into stringers. Install ladders so that the distance from the rungs to the finished surface will not be less than 7 inches. Provide heavy clip angles riveted or bolted to the stringer. Provide intermediate clip angles not over 48 inches on centers.

2.3.1 Ladder Cages

Conform to 29 CFR 1910.27. Fabricate 2 by 1/4 inch horizontal bands and 1 1/2 by 3/16 inch vertical bars. Provide attachments for fastening bands to the side rails of ladders or directly to the structure. Provide and fasten vertical bars on the inside of the horizontal bands. Extend cages not less than 27 inches or more than 28 inches from the centerline of the rungs, excluding the flare at the bottom of the cage, and not less than 27 inches in width. Clear the inside of the cage of projections.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Provide Exposed fastenings of compatible materials, generally matching in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners will be cause for

rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports must provide strength and stiffness. Form joints exposed to the weather to exclude water. Items listed below require additional procedures.

3.2 WORKMANSHIP

Metalwork must be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching must produce clean true lines and surfaces. Continuously weld along the entire area of contact. Do not tack weld exposed connections of work in place. Grind smooth exposed welds. Provide smooth finish on exposed surfaces of work in place, unless otherwise approved. Where tight fits are required, mill joints. Cope or miter corner joints, well formed, and in true alignment. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion anchors, and powder-actuated fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine bolts, carriage bolts and powder-actuated threaded studs for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.5 FINISHES

3.5.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with an anti-corrosive metal alkyd primer similar to MPI 79 with a VOC content of less than 250 g/L, to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

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SECTION 05 52 00

METAL RAILINGS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for metal railing systems which are not a part of any other metals system of the specification.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A500/A500M	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 521	Pipe Railing Manual

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings

Iron and Steel Hardware

Steel Shapes, Plates, Bars and Strips

SD-03 Product Data

Structural Steel Plates, Shapes, and Bars

Structural Steel Tubing

Protective Coating

Steel Railings and Handrails

Anchorage and Fastening Systems

SD-07 Certificates

Welder Qualification

SD-08 Manufacturer's Instructions

Installation Instructions

1.4 QUALITY ASSURANCE

1.4.1 Welder Qualification

Submit certified welder qualification by tests in accordance with AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide complete, detailed fabrication and installation drawings for all iron and steel hardware, and for all steel shapes, plates, bars and strips used in accordance with the design specifications referenced in this section.

Pre-assemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and application of surface finishes, including zinc coatings.

2.2 GENERAL FABRICATION

Provide railings and handrails detail plans and elevations at not less than 1 inch to 1 foot. Provide details of sections and connections at not less than 3 inches to 1 foot. Also detail setting drawings, diagrams, templates for installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchors.

Use materials of size and thicknesses indicated or, if not indicated, of required size and thickness to produce adequate strength and durability in finished product for intended use. Work materials to dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use type of materials indicated or specified for the various components of work.

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ensure all exposed edges are eased to a radius of approximately 1/32 inch. Bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Weld corners and seams continuously and in accordance with the recommendations of AWS D1.1/D1.1M. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Form exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use Phillips flathead (countersunk) screws or bolts.

Provide anchorage of the type indicated and coordinated with the supporting structure. Fabricate anchoring devices and space as indicated and as required to provide adequate support for the intended use of the work.

Use hot-rolled steel bars for work fabricated from bar stock unless work is indicated or specified to be fabricated from cold-finished or cold-rolled stock.

2.3 STRUCTURAL STEEL PLATES, SHAPES AND BARS

Provide steel bars and bar-size shapes conforming to ASTM A36/A36M, unless otherwise noted.

2.4 STRUCTURAL STEEL TUBING

Provide structural steel tubing, hot-formed, welded or seamless, conforming to ASTM A500/A500M, Grade B, unless otherwise noted.

2.5 STEEL PIPE

Provide pipe conforming to ASTM A53/A53M, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

2.6 FASTENERS

Provide galvanized zinc-coated fasteners in accordance with ASTM A153/A153M used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of steel stair items.

Provide standard hexagon-head bolts, conforming to ASTM A307, Grade A.

2.7 PROTECTIVE COATING

Provide hot dipped galvanized steelwork as indicated in accordance with ASTM A123/A123M. Touch up abraded surfaces and cut ends of galvanized members with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.

2.8 STEEL RAILINGS AND HANDRAILS

Design handrails to resist a concentrated load of 250 lbs in any direction at any point of the top of the rail or 50 lbs per foot applied horizontally to top of the rail, whichever is more severe. NAAMM AMP 521, provide the same size rail and post. Provide pipe collars of the same material and finish as the handrail and posts.

2.8.1 Steel Handrails

Provide steel handrails, including inserts in concrete, steel pipe conforming to ASTM A53/A53M. Provide steel railings of 1 1/2 inches nominal size, hot-dip galvanized.

a. Fabrication: Joint posts, rail, and corners by one of the following methods:

   1. Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal-recessed-head setscrews.

   2. Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight fitting interior sleeve not less than 6 inches long.

   3. Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

Provide kickplates between railing posts where indicated, and consist of 1/4 -inch steel flat bars not less than 6 inches high. Secure kickplates as indicated.

Provide galvanized railings, including pipe, fittings, brackets, fasteners, and other ferrous metal components.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

Submit manufacturer's installation instructions for the following products to be used in the fabrication of stair railing and hand rail work:

a. Structural steel plates, shapes, and bars

b. Structural steel tubing

c. Steel railings and handrails

d. Anchorage and fastening systems

Provide complete, detailed fabrication drawings and installation drawings for all iron and steel hardware, and for all steel shapes, plates, bars and strips used in accordance with the design specifications referenced in this section.

3.2 PREPARATION

Adjust stair railings and handrails prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Space posts not more than 6 feet on center. Plumb posts in each direction. Secure posts and rail ends to stair construction.

Install toe boards and brackets where indicated. Make splices, where required, at expansion joints. Install removable sections as indicated.

3.3 STEEL HANDRAIL

Weld to stair railings with support brackets as required and return ends of handrails to stair railing posts.

3.4 FIELD WELDING

Ensure procedures of manual shielded metal arc welding, appearance and quality of welds made, and methods used in correcting welding work comply with AWS D1.1/D1.1M.

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METAL ROOF PANELS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for both factory color and mill finish aluminum or steel non-structural metal roofing.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

ANSI/AISC 341	Seismic Provisions for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG03-3	Cold-Formed Steel Design Manual Set

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-10	Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A755/A755M	Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A792/A792M	Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM C 920	Standard Specification for Elastomeric Joint Sealants
ASTM C 792	Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants
ASTM C 920	Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1667	Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D 2247	Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	Measuring Adhesion by Tape Test
ASTM D 4214	Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 522	Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	Standard Test Method for Specular Gloss
ASTM D 5894	Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D 610	Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D 714	Evaluating Degree of Blistering of Paints

ASTM D 822	Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D 968	Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E 1592	Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM G 152	Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G 153	Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

FM GLOBAL (FM)

FM 4471	Class I Panel Roofs

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA RSDM	Metal Roofing Systems Design Manual

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0405	Roofing and Waterproofing Manual
NRCA 0409	Architectural Sheet Metal and Metal Roofing Manual

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	Architectural Sheet Metal Manual, 6th Edition

UNDERWRITERS LABORATORIES (UL)

UL 580	Tests for Uplift Resistance of Roof Assemblies
UL Bld Mat Dir	Building Materials Directory

1.3 DESCRIPTION OF METAL ROOF SYSTEM

1.3.1 Performance Requirements

Steel panels and accessory components must conform to the following standards:

ASTM A1008/A1008M
ASTM A123/A123M
ASTM A36/A36M
ASTM A755/A755M for metallic coated steel sheet for exterior coil prepainted applications.
ASTM D 522 for applied coatings

UL Bld Mat Dir

1.3.1.1 Wind Uplift Resistance

Provide metal roof panel system that conform to the requirements of ASTM E 1592 and UL 580. Uplift force due to wind action governs the design for panels. Submit wind uplift test report prior to commencing installation.

Roof system and attachments must resist the wind loads as determined by ASCE 7-10, in pounds per square foot. Metal roof panels and component materials must also comply with the requirements in FM 4471 as part of a panel roofing system as listed in Factory Mutual Guide (FMG) "Approval Guide" for class 1 or noncombustible construction, as applicable. Identify all materials with FMG markings.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roofing Panels

Flashing and Accessories

Gutter/Downspout Assembly

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Roof panels

Factory-Applied Color Finish

Accessories

Fasteners

Pressure Sensitive Tape

Gaskets and Sealing/Insulating Compounds

Coil Stock

Aluminized Steel Repair Paint

Enamel Repair Paint

SD-04 Samples

Roof Panels

Factory-applied Color Finish, samples, 9 inch lengths, full width

Accessories

Fasteners

Gaskets and Sealant/Insulating Compounds

SD-05 Design Data

Wind Uplift Resistance

SD-06 Test Reports

Wind Uplift Test Report

Factory Finish and Color Performance Requirements

SD-07 Certificates

Roof Panels

Coil stock compatibility

Qualification of Manufacturer

Qualification of Applicator

SD-08 Manufacturer's Instructions

INSTALLATION MANUAL

SD-09 Manufacturer's Field Reports

Manufacturer's Field Inspection Reports

SD-11 Closeout Submittals

Warranties

Information Card

1.5 QUALITY ASSURANCE

1.5.1 Qualification of Manufacturer

Submit documentation verifying metal roof panel manufacturer has been in the business of manufacturing metal roof panels for a period of not less than 5 years.

Manufacturer must also provide engineering services by an authorized engineer, currently licensed in the geographic area of the project, with a minimum of five (5) years experience as an engineer knowledgeable in roof wind design analysis, protocols and procedures for MBMA RSDM, ASCE 7-10, UL 580, and FM 4471. Engineer must provide certified engineering calculations for the project conforming to the stated references.

1.5.1.1 Manufacturer's Technical Representative

The manufacturer's technical representative must be thoroughly familiar with the products to be installed, installation requirements and practices, and with any special considerations in the geographical area of the project. The representative must perform field inspections and attend

meetings as specified.

1.5.1.2 Single Source

Roofing panels, clips, closures, and other accessories must be standard products of the same manufacturer, and the most recent design of the manufacturer to operate as a complete system for the intended use.

1.5.2 Qualification of Applicator

Metal roof system applicator must be approved, authorized, or licensed in writing by the roof panel manufacturer and have a minimum of three years experience as an approved, authorized, or licensed applicator with that manufacturer, approved at a level capable of providing the specified warranty. Supply the names, locations and client contact information of 5 projects of similar size and scope constructed by applicator using the manufacturer's roofing products submitted for this project within the previous three years.

1.5.3 Qualifications for Welding Work

Welding procedures must conform to AWS D1.1/D1.1M for steel.

Operators are permitted to make only those types of weldments for which each is specifically qualified.

1.5.4 Pre-roofing Conference

After approval of submittals and before performing roofing system installation work, hold a pre-roofing conference to review the following:

a. Drawings, specifications, and submittals related to the roof work. Submit, as a minimum; sample profiles of roofing panels, with factory-applied color finish samples, flashing and accessories, gutter/downspout assembly samples, typical fasteners and pressure sensitive tape, sample gaskets and sealant/insulating compounds. Also include data and 1 pint sample of aluminized steel repair paint and enamel repair paint, and technical data on coil stock and coil stock compatibility, and manufacturer's installation manual.

b. Roof system components installation;

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representative;

d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

e. Quality control plan for the roof system installation;

f. Safety requirements.

Coordinate pre-roofing conference scheduling with the COR. Attendance is mandatory for the Contractor, the COR's designated personnel, personnel directly responsible for the installation of metal roof system, flashing

and sheet metal work, other trades interfacing with the roof work, and representative of the metal roofing manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.6 DELIVERY, HANDLING, AND STORAGE

Deliver, store, and handle panel materials, bulk roofing products, accessories, and other manufactured items in a manner to prevent damage and deformation, as recommended by the manufacturer, and as specified.

1.6.1 Delivery

Package and deliver materials to the site in undamaged condition. Provide adequate packaging to protect materials during shipment. Do not uncrate materials until ready for use, except for inspection. Immediately upon arrival of materials at jobsite, inspect materials for damage, deformation, dampness, and staining. Remove affected materials from the site and immediately replace. Remove moisture from wet materials not otherwise affected, restack and protect from further moisture exposure.

1.6.2 Handling

Handle materials in a manner to avoid damage. Select and operate material handling equipment so as not to damage materials or applied roofing.

1.6.3 Storage

Stack materials stored on site on platforms or pallets, and cover with tarpaulins or other weathertight covering which prevents trapping of water or condensation under the covering. Store roof panels so that water which may have accumulated during transit or storage will drain off. Do not store panels in contact with materials that might cause staining. Secure coverings and stored items to protect from wind displacement.

1.7 PROJECT CONDITIONS

Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit metal roof panel work to be performed according to manufacturer's written instructions and warranty requirements, and specified safety requirements.

1.8 FABRICATION

Fabricate and finish metal roof panels and accessories on a factory stationary industrial type rolling mill to the greatest extent possible, per manufacturer's standard procedures and processes, and as necessary to fulfill indicated performance requirements. Comply with indicated profiles, dimensional and structural requirements.

Provide panel profile, as indicated on drawings for full length of panel. Fabricate panel side laps with factory installed separator strips providing a weather tight seal and preventing metal-to metal contact, and minimizing noise from movements within the panel assembly.

1.8.1 Finishes

Finish quality and application processes must conform to the related

standards specified within this section. Noticeable variations within the same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize any contrasting variations.

1.8.2 Accessories

Fabricate flashing and trim to comply with recommendations in SMACNA 1793 as applicable to the design, dimensions, metal, and other characteristics of the item indicated.

a. Form exposed sheet metal accessories which are free from excessive oil canning, buckling, and tool marks, and are true to line and levels indicated, with exposed edges folded back to form hems.

b. End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

c. Sealed Joints: Form non-expansion, but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA 1793.

d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

e. Fabricate cleats and attachments devices of size and metal thickness recommended by SMACNA or by metal roof panel manufacturer for application, but not less than the thickness of the metal being secured.

1.9 WARRANTIES

Provide metal roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to manufacturer's standard warranty as required to comply with the specified requirements.

1.9.1 Metal Roof Panel Manufacturer Warranty

Furnish the metal roof panel manufacturer's 20-year no dollar limit roof system materials and installation workmanship warranty, including flashing, components, trim, and accessories necessary for a watertight roof system construction. Make warranty directly to the Government, commencing at time of Government's acceptance of the roof work. The warranty must state that:

a. If within the warranty period, the metal roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, displaces, corrodes, perforates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the metal roof system and correction of defective workmanship is the responsibility of the metal roof panel manufacturer. All costs associated with the repair or replacement work are the responsibility of the metal roof panel manufacturer.

b. If the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.

1.9.2 Manufacturer's Finish Warranty

Provide a manufacturer's no-dollar-limit 20 year warranty for the roofing system. Issue the warranty directly to the Government at the date of Government acceptance warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D 4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D 2244.

1.9.3 Continuance of Warranty

Repair or replacement work that becomes necessary within the warranty period must be approved, as required, and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the metal roof system manufacturer warranty for the remainder of the manufacturer warranty period.

1.10 CONFORMANCE AND COMPATIBILITY

The entire metal roofing and flashing system must be in accordance with specified and indicated requirements, including wind resistance and seismic per ANSI/AISC 341 requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the MBMA RSDM, NRCA 0405, the metal panel manufacturer's published recommendations and details, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the COR for approval prior to installation.

PART 2 PRODUCTS

2.1 ROOF PANELS

2.1.1 Steel Sheet Panels

Roll-form steel sheet roof panels to the specified profile, with fy = 50 ksi, gauge as determined by manufacturer to meet specified requirements. Material must be plumb and true, and within the tolerances listed:

a. Aluminum-Zinc alloy coated steel sheet conforming to ASTM A792/A792M and AISI SG03-3.

b. Provide panels with thermal expansion and contraction consistent with the type of system specified, and the following profile:

   1. PBU Panel profile with 3/4 inch high rib at 6 inches o.c., 38 inch overall panel width with 36 inch exposed panel and exposed fasteners.

2.2 FACTORY FINISH AND COLOR PERFORMANCE REQUIREMENTS

All panels are to receive a factory applied Kynar 500/Hylar 5000 finish consisting of a baked topcoat with a manufacturer's recommended prime coat conforming to the following:

a. Metal Preparation: All metal is to have the surfaces carefully prepared for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with an acid rinse, and thorough

drying.

b. Prime Coating: A base coat of epoxy paint, specifically formulated to interact with the top-coat, is to be applied to the prepared surfaces by roll coating to a dry film thickness of 0.20 plus 0.05 mils. The prime coat must be oven cured prior to application of the finish coat.

c. Exterior Finish Coating: Apply the exterior finish coating over the primer by roll coating to a dry film thickness of 0.80 plus 0.05 mils for a total dry film thickness of 1.00 plus 0.10 mils . This exterior finish coat must be oven-cured.

d. Interior finish coating: Apply a wash coat on the reverse side over primer by roll coating to a dry film thickness of 0.30 plus 0.05 mils for a total dry fill thickness of 0.50 plus 0.10 mils. The wash coat must be oven cured.

e. Color: The exterior finish chosen from the manufacturer's standard color chart for closest match to color as specified in Section 09 06 90 COLOR SCHEDULE.

f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

General:	ASTM D 5894 and ASTM D 4587.
Abrasion:	ASTM D 968
Adhesion:	ASTM D 3359
Chalking:	ASTM D 4214
Color Change and Conformity:	ASTM D 2244
Flame Spread:	ASTM E 84
Flexibility:	ASTM D 522
Formability:	ASTM D 522
Humidity:	ASTM D 2247 and ASTM D 714
Oxidation:	ASTM D 610
Pencil Hardness:	ASTM D 3363
Reverse Impact:	ASTM D 2794
Salt Spray:	ASTM B 117
Weatherometer:	ASTM G 152, ASTM G 153 and ASTM D 822

2.2.1 Specular Gloss

Finished roof surfaces to have a specular gloss value of 10 or less at an angle of 85 degrees when measured in accordance with ASTM D 523.

2.3 MISCELLANEOUS METAL FRAMING

2.3.1 Fasteners and Miscellaneous Metal Framing

Provide compatible type, corrosion resistant, of sufficient size and length to penetrate the supporting element a minimum of one inch with other required properties to fasten miscellaneous metal framing members to substrates in accordance with the roof panel manufacturer's and ASCE 7-10 requirements.

2.3.1.1 Exposed Fasteners

Fasteners for roof panels must be corrosion resistant stainless steel, compatible with the sheet panel or flashing material and of the type and size recommended by the manufacturer to meet the performance requirements and design loads. Fasteners for accessories must be the manufacturer's standard. Provide an integral metal washer, matching the color of attached material with compressible sealing EPDM gasket approximately 3/32 inch thick for exposed fasteners.

2.3.1.2 Screws

Provide corrosion resistant screws, stainless steel of the type and size recommended by the manufacturer to meet the performance requirements.

2.3.1.3 Attachment Clips

Provide hot-dip galvanized, conforming to ASTM A653/A653M, clips. Size, shape, thickness and capacity must meet the thickness and design load criteria specified.

2.3.2 Electrodes for Manual, Shielded Metal Arc Welding

Electrodes for manual, shielded metal arc welding must meet the requirements of AWS D1.1/D1.1M, and be covered, mild-steel electrodes conforming to AWS A5.1/A5.1M.

2.4 ACCESSORIES

Accessories must be compatible with the metal roof panels. Sheet metal flashing, trim, metal closure strips, caps, and similar metal accessories must be not less than the minimum thicknesses specified for roof panels. Provide exposed metal accessories to match the panels furnished. Molded foam rib, ridge and other closure strips must be closed-cell or solid-cell synthetic rubber or neoprene premolded to match configuration of the panels and not absorb or retain water.

2.4.1 Pre-manufactured Accessories

Pre-manufactured accessories must be manufacturer's standard for intended purpose, compatible with the metal roof system and approved for use by the metal roof panel manufacturer. Construct curbs to match roof slope.

2.4.2 Metal Closure Strips

Provide factory fabricated steel closure strips of the same gauge, color, finish and profile as the specified roof panel.

2.4.3 Rubber Closure Strips

Provide closed-cell, expanded cellular rubber closure strips conforming to ASTM D 1056 and ASTM D 1667, extruded or molded to the configuration of the specified roof panel profile and in lengths supplied by roof panel manufacturer.

2.5 JOINT SEALANTS

2.5.1 Sealants

Sealants are to be an approved gun type for use in hand or air pressure caulking guns at temperatures above 40 degrees F (or frost-free application at temperatures above 10 degrees F) with a minimum solid content of 85 percent of the total volume. Sealant must dry with a tough, durable surface skin which permits it to remain soft and pliable underneath, providing a weather tight joint. No migratory staining, in conformance with to ASTM C 792, is permitted on painted or unpainted metal, stone, glass, vinyl or wood.

Prime all joints to receive sealants with a compatible one-component or two-component primer as recommended by the roof panel manufacturer.

2.5.1.1 Field Applied Sealants

Sealants for field-applied caulking must be an approved gun grade, non-sag on-component polysulfide or two component polyurethane with an initial maximum Shore A durometer hardness of 25, conforming to ASTM C 920, Type II. Color to match panel color.

2.5.1.2 Tape Sealants

Provide pressure sensitive, 100 percent solid tape sealant with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the roof panel manufacturer.

2.5.2 Sheet Metal Flashing and Trim

2.5.2.1 Fabrication, General

Custom fabricate sheet metal flashing and trim to comply with recommendations within the SMACNA 1793 that apply to design, dimensions, metal type, and other characteristics of design indicated. Shop fabricate items to the greatest extent possible. Obtain and verify field measurements for accurate fit prior to shop fabrication. Fabricate flashing and trim without excessive oil canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

2.5.2.2 Roof Drainage Sheet Metal Fabrications

Gutters: Fabricate to cross section indicated, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required. Fabricate in minimum 96 inch long sections. Fabricate expansion joints and accessories from the same metal as gutters, unless otherwise indicated.

Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangars of same material as downspouts and anchors.

2.6 GASKETS AND SEALING/INSULATING COMPOUNDS

Gaskets and sealing/insulating compounds must be nonabsorptive and suitable for insulating contact points of incompatible materials. Sealing/insulating compounds must be non-running after drying.

2.7 FINISH REPAIR MATERIAL

Repair paint for color finish enameled roofing must be compatible paint of the same formula and color as the specified finish furnished by the manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the work. Ensure surfaces are suitable, dry and free of defects and projections which might affect the installation.

Examine primary and secondary roof framing to verify that the structural metal deck and other structural support members for panels and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer, UL, ASTM, and ASCE 7-10 and applicable seismic requirements.

Examine rough-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of panels prior to installation.

Submit a written report to the COR, endorsed by the installer, listing conditions detrimental to the performance of the work. Proceed with installation only after defects have been corrected.

3.2 INSTALLATION

Installation must meet specified requirements and be in accordance with the manufacturer's installation instructions and approved shop drawings. Do not install damaged materials. Dissimilar materials which are not compatible when contacting each other must be insulated by means of gaskets or sealing/insulating compounds. Keep all exposed surfaces and edges clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Remove stained, discolored, or damaged materials from the site.

3.2.1 Preparation

Clean all substrate substances which may be harmful to roof panels including removing projections capable of interfering with with roof panel attachment.

Install eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written instructions.

3.3 PROTECTION OF APPLIED MATERIALS

Do not permit storing, walking, wheeling, and trucking directly on applied roofing/insulation materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to applied roofing/insulation materials, and to distribute weight to conform to indicated live load limits of roof construction.

3.4 FASTENER INSTALLATION

Anchor metal roof panels and other components of the Work securely in place, using approved fasteners according to manufacturer's written instructions.

3.4.1 Welding

Procedures for manual, shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work must be in accordance with AWS D1.1/D1.1M.

3.5 FLASHING, TRIM, AND CLOSURE INSTALLATION

3.5.1 General Requirements

Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently water tight and weather resistant. Work is to be accomplished to form weather tight construction without waves, warps, buckles, fastening stresses or distortion, and to allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accomplish the work must conform to the manufacturers written instructions.

3.5.2 Metal Flashing

Install exposed metal flashing at building corners, rakes, eaves, flue, vent and pipe penetrations, junctions between metal siding and roofing, valleys and changes of slope or direction in metal roofing, building expansion joints and gutters.

Exposed metal flashing must be the same material, color, and finish as the specified metal roofing panels. Furnish flashing in minimum 8 foot lengths. Exposed flashing must have 1 inch locked and blind soldered end joints, with expansion joints at intervals of no greater than 16 feet.

Fasten flashing at not more than 6 inches on center for roofs, except where flashing is held in place by the same screws used to secure panels. Exposed flashing and flashing subject to rain penetration must be bedded in specified joint sealant. Flashing which is contact with dissimilar metals must be isolated by means of the specified asphalt mastic material to prevent electrolytic deterioration.

Form drips to the profile indicated, with the edge folded back 1/2 inch to form a reinforced drip edge.

3.6 ROOF PANEL INSTALLATION

Provide metal roof panels of full length from eave to ridge or eave to wall as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels or other components of the Work securely in place, with provisions for thermal and structural movement in accordance with NRCA 0409.

Steel Roof Panels: Use stainless steel fasteners for exterior surfaces and galvanized fasteners for unexposed surfaces.

Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using approved fasteners according to manufacturer's written instructions. Provide all blocking and nailers as required.

Metal Protection: Where dissimilar metals contact each other or possibly corrosive substrates, protect against galvanic action by permanent separation as recommended by the metal roof panel manufacturer.

Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and required for weatherproof performance of metal roof panel system. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

3.6.1 Handling and Erection

Erect roofing system in accordance with the approved erection drawings, printed instructions and safety precautions of the manufacturer.

Do not subject panels to overloading, abuse, or undue impact. Do not apply bent, chipped, or defective panels. Damaged panels must be replaced and removed from the site at the contractors expense. Erect panels true, plumb, and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with indicated rake, eave, and curb overhang. Allow for thermal movement of the roofing, movement of the building structure, and provide permanent freedom from noise due to wind pressure.

Do not permit storage, walking, wheeling or trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to the installed roofing materials, and to distribute weight to conform to the indicated live load limits of the roof construction.

Roof panels must be laid with corrugations in the direction of the roof slope. End laps of exterior roofing must not be less than 8 inches; side laps of standard exterior corrugated panels must not be less than 1-1/2 corrugations.

Field cutting of metal roof panels by torch is not permitted. Field cut only as recommended by manufacturer's written instructions.

3.6.2 Closure Strips

Install metal closure strips at open ends of metal ridge rolls; open ends of corrugated or ribbed pattern roofs, and at intersection of wall and roof, unless open ends are concealed with formed eave flashing; rake of metal roof unless open end has a formed flashing member; and in other required areas.

Install closure strips at intersection of the wall with metal roofing; top and bottom of metal siding; heads of wall openings; and in other required locations.

3.6.3 Workmanship

Make lines, arises, and angles sharp and true. Free exposed surfaces from any visible wave, warp, buckle and tool marks. Fold back exposed edges

neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and as necessary to make the work watertight.

3.7 ACCEPTANCE PROVISIONS

3.7.1 Erection Tolerances

Erect metal roofing straight and true with plumb vertical lines correctly lapped and secured in accordance with the manufacturer's written instructions.

3.7.2 Leakage Tests

Finished application of metal roofing is to be subject to inspection and test for leakage by the COR or his designated representative, and Architect/Engineer. Inspection and tests will be conducted without cost to the Government.

Inspection and testing is to be made promptly after erection to permit correction of defects and removal/replacement of defective materials.

3.7.3 Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired with the specified repair materials and as recommended by the metal roof panel manufacturer. Finished repaired surfaces must be uniform and free from variations of color and surface texture. Repaired metal surfaces that are not acceptable to the project requirements are to be immediately removed and replaced with new material.

3.7.4 Paint Finished Metal Roofing

Paint finished metal roofing will be tested for color stability by the COR during the manufacturer's specified guarantee period. Panels that indicate color changes, fading, or surface degradation, determined by visual examination, must be removed and replaced with new panels at no expense to the Government. New panels will be subject to the specified tests for an additional year from the date of their installation.

3.8 CLEAN UP AND DISPOSAL

Clean exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from roofs. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces must be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating. Touch up scratches in panel finish with manufacturer supplied touch-up paint system to match panel finish. Treat exposed cut edges with manufacturer supplied clear coat.

Collect all scrap/waste materials and place in containers. Promptly dispose of demolished and scrap materials. Do not allow scrap/waste materials to accumulate on-site; transport immediately from the government property and legally dispose of them.

3.9 FIELD QUALITY CONTROL

3.9.1 Manufacturer's Inspection

Manufacturer's technical representative must visit the site during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Make inspections during the first 20 squares of roof panel installation, and at substantial completion, at a minimum. Follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the COR. After each inspection, submit a report, signed by the manufacturer's technical representative to the COR within 3 working days. Note in the report overall quality of work, deficiencies and any other concerns, and recommended corrective action.

Submit three signed copies of the manufacturer's field inspection reports to the COR within one week of substantial completion.

3.10 INFORMATION CARD

For each roof, furnish a typewritten information card for facility records.

Make card 8 1/2 by 11 inches minimum. Information card must identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, roof panel manufacturer and product name, date of completion; installing contractor identification and contact information; manufacturer warranty expiration, warranty reference number, and contact information. Submit to the COR.

-- End of Section --

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SECTION 07 42 13

METAL WALL PANELS

PART 1 GENERAL

1.1 SUMMARY

This section covers both factory color and mill finish aluminum or steel non-structural metal wall panels.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

ANSI/AISC 341	Seismic Provisions for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100	North American Specification for the Design of Cold-Formed Steel Structural Members
AISI SG03-3	Cold-Formed Steel Design Manual Set

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-10	Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A36/A36M	Standard Specification for Carbon Structural Steel

ASTM A606/A606M	Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A755/A755M	Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A792/A792M	Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM C 920	Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1667	Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D 2794	Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	Measuring Adhesion by Tape Test
ASTM D 3363	Film Hardness by Pencil Test
ASTM D 4214	Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 522	Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	Standard Test Method for Specular Gloss
ASTM D 5894	Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D 610	Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D 714	Evaluating Degree of Blistering of Paints
ASTM D 822	Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings

ASTM D 968	Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E 1592	Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM G 152	Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G 153	Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA MBSM	Metal Building Systems Manual

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	Metal Finishes Manual

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	Architectural Sheet Metal Manual, 6th Edition

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	Building Materials Directory

1.3 DEFINITIONS

Metal Wall Panel: Metal wall panels, attachment system components and accessories necessary for a complete weather-tight wall system.

1.4 DESCRIPTION OF WALL PANEL SYSTEM

Factory color finished, galvalume metal wall panel system with exposed fastener attachment. Panel profile must be corrugated.

1.4.1 Metal Wall Panel General Performance

Comply with performance requirements, conforming to AISI S100, without failure due to defective manufacture, fabrication, installation, or other defects in construction. Wall panels and accessory components must conform to the following standards:

ASTM A1008/A1008M
ASTM A123/A123M
ASTM A36/A36M
ASTM A653/A653M
ASTM A606/A606M
ASTM A755/A755M for metallic coated steel sheet for exterior coil pre-painted applications.
ASTM D 522 for applied coatings
UL Bld Mat Dir

1.4.2 Structural Performance

Maximum calculated fiber stress must not exceed the allowable value in the AISI or AA manuals; a one third overstress for wind is allowed. Midspan deflection under maximum design loads is limited to L/180. Contract drawings show the design wind loads and the extent and general assembly details of the metal siding. Contractor must provide design for members and connections not shown on the drawings. Siding panels and accessories must be the products of the same manufacturer.

Provide metal wall panel assemblies complying with the load and stress requirements in accordance with ASTM E 1592. Wind Load force due to wind action governs the design for panels.

Wall systems and attachments are to resist the wind loads as indicated on the Structural Drawings, General Note for wind load criteria. Submit five copies of wind load tests and seismic tests to the COR.

Provide metal wall panel assembly for seismic conditions complying with the applicable requirements of ANSI/AISC 341.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Documentation for the following items:

Qualification of Manufacturer
Qualification of Installation Contractor

Sample Warranty

SD-02 Shop Drawings

Installation Drawings

SD-03 Product Data

Submit Manufacturer's catalog data for the following items:

Wall Panels

Factory Color Finish
Closure Materials
Pressure Sensitive Tape
Sealants and Caulking
Enamel Repair Paint
Aluminized Steel Repair Paint
Accessories

SD-04 Samples

Submit as required each of the following samples:

Wall Panels, 12 inches long by actual panel width

Fasteners
Metal Closure Strips, 10 inches long of each type
Color chart and chips

Submit manufacturer's standard color charts and chips, approximately 4 by 4 inches, showing colors available for wall panels with factory applied finishes comparable to color specified in Section 09 06 90 COLOR SCHEDULE.

SD-05 Design Data

Wind load design analysis

As applicable, submit the following wind load design analysis data, to include, but not limited to:

wind speed
exposure category,co-efficient,importance factor
type of facility
negative pressures for each zone
methods and requirements of attachment

SD-06 Test Reports

Submit test reports for the following in accordance with the referenced articles in this section.

Wind Load Tests
Coating Tests
Chalking Tests
Seismic Tests

SD-07 Certificates

Submit certificates for the following items showing conformance with referenced standards contained in this section:

Coil Stock
Fasteners
Enamel Repair Paint

SD-08 Manufacturer's Instructions

Include detailed application instructions and standard manufacturer drawings altered as required by these specifications.

Installation of Wall panels

SD-09 Manufacturer's Field Reports

Submit Manufacturer's Field Reports

SD-11 Closeout Submittals

Warranty
Maintenance Instructions

20 year "No Dollar Limit" warranty for labor and material

1.6 QUALITY ASSURANCE

1.6.1 Pre-Installation Conference

Upon notification of submittal receipt and approval by the COR; and prior to the commencement of the work, the Contractor must attend a pre-installation conference to review the following:

a. Drawings and Specifications.

b. Qualification of Installer.

c. Approved Warranty

d. Sample wall panels, 12 inches long by actual panel width

e. Sample metal closure strips, 10 inches long of each type

f. Color charts and chips

g. Coatings and base metal tests, chalking tests

h. Construction schedule, availability of materials, Installer's personnel, equipment and facilities required to progress with the work without delay.

i. Methods and procedures related to installation of wall panels, including manufacturer's written instructions. Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements.

j. Support conditions for compliance with requirements, including alignment between and attachment to structural members.

k. Flashing, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.

l. Governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.

m. Temporary protection requirements for metal wall panel assembly during and after installation.

n. Wall panel observation and repair procedures after metal wall panel installation. Provide detailed written instructions including copies of Material Safety Data Sheets for maintenance and repair materials, and manufacturer's maintenance instructions.

1.6.1.1 Installation Drawings

Installation shop drawings for wall panels, flashing, accessories, and anchorage systems must indicate completely dimensioned structural frame and erection layouts, openings in the wall, special framing details, and construction details at corners,canopy roof intersections and flashing, location and type of mastic and metal filler strips.

1.6.1.2 Wind Load Design Analysis

Wind design analysis must include wall plan delineating dimensions and

attachment patterns for each zone. Wind design analysis must be prepared and sealed by Licensed Project Engineer in the geographic area where the construction will take place.

1.6.2 Manufacturer's Technical Representative

The representative must have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and installations in the geographical area where construction will take place.

1.6.3 Qualification of Manufacturer

Certify that metal wall panel system manufacturer has a minimum of five (5) years experience in manufacturing metal wall system and accessory products.

Manufacturer must also provide engineering services by an authorized engineer; currently licensed in the geographical area where construction will take place, having a minimum of four (4) years experience as an engineer knowledgeable in wind load design analysis, protocols and procedures per MBMA MBSM, "Metal Building Systems Manual"; ASCE 7-10, and ASTM E 1592.

Provide certified engineering calculations, using the products submitted, for Wind load requirements in accordance with ASCE 7-10.

1.6.3.1 Manufacturer's Certificates

Also provide the following certifications from the manufacturer:

Coil Stock
Fasteners
Enamel Repair Paint

Submit certification from coil stock manufacturer or supplier that the machinery used will form the provided coil stock without warping, waviness, or rippling that is not a part of the panel profile, and without damage, abrasion or marring of the finish coating.

Provide evidence that products used within this specification are manufactured in the United States.

1.6.4 Certified Qualification of Installation Contractor

The installation contractor must be approved and certified by the metal wall panel manufacturer prior to beginning the installation of the metal wall panel system. Subcontracting by Certified Contractor for the metal wall panel work is not permitted.

1.6.5 Single Source

Obtain each type of metal wall panels, clips, closure materials and other accessories from the standard products of the single source from a single manufacturer to operate as a complete system for the intended use.

1.6.6 Manufacturer's Maintenance Instructions

Provide manufacturer's detailed written instructions including copies of Material Safety Data Sheets for maintenance and repair materials.

1.7 DELIVERY, HANDLING, AND STORAGE

Deliver and protect package components, sheets, metal wall panels, and other manufactured items to prevent damage or deformation during transportation and handling.

Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

Stack and store metal wall panels horizontally on platforms or pallets, covered with suitable weather-tight and ventilated covering to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

Retain strippable protective covering on metal wall panel until actual installation.

1.8 PROJECT CONDITIONS

1.8.1 Field Measurements

Verify locations of wall framing and opening dimensions by field measurements before metal wall panel fabrication and indicate measurements on Shop Drawings.

1.8.2 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into wall system or building.

1.9 WARRANTY

Warranty must conform to the Sample Warranty as reviewed and approved by the COR.

1.9.1 20 Year "No Dollar Limit" Warranty for Labor and Material

Furnish manufacturer's no-dollar-limit warranty for the metal wall panel system. The warranty period is to be no less than twenty (20) years from the date of Government acceptance of the work. The warranty is to be issued directly to the Government. The warranty is to provide that if within the warranty period the metal wall panel system shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the wall panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal wall panel system manufacturer. Repairs that become necessary because of defective materials and workmanship while metal wall panel system is under warranty are to be performed within 24 hours after notification, unless additional time is approved by the COR. Failure to perform repairs within 24 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty.

PART 2 PRODUCTS

2.1 FABRICATION

Unless approved otherwise, fabricate and finish metal wall panels and

accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated and specified performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

2.1.1 Sheet Metal Accessories

Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated:

a. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

b. End Seams: fabricate nonmoving end seams with flat-lock seams. Form seams and seal with epoxy seam sealer.

c. Sealed Joints: form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA 1793.

d. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA 1793 or by metal wall panel manufacturer for application, but not less than thickness of metal being secured.

2.2 PANEL MATERIALS

2.2.1 Steel Sheet

Roll-form steel wall panels to the specified profile, with fy= 50 ksi, gauge as determined by manufacturer to meet specified requirements. Material must be plumb and true, and within the tolerances listed:

a. Aluminum-Zinc Alloy-coated Steel Sheet conforming to ASTM A792/A792M and AISI SG03-3.

b. Individual panels must be continuous length to cover the entire length of any unbroken wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

c. Provide panels with thermal expansion and contraction consistent with the type of system specified.

    1. PBU Panel Profile with a 3/4 inch high rib at 6 inches o.c., with 36 inch coverage and exposed fasteners.

    2. Smooth, flat Surface Texture.

2.2.2 Factory Color Finish

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes. Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

All panels are to receive a factory-applied Kynar 500/Hylar 5000 finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat conforming to the following:

2.2.2.1 Metal Preparation

Carefully prepare all metal surface for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with acid rinse, and thorough drying.

2.2.2.2 Prime Coating

Apply a base coat of epoxy paint, specifically formulated to interact with the top-coat, to the prepared surfaces by roll coating to a dry film thickness of 0.20 plus 0.05 mils. Prime coat must be oven cured prior to application of finish coat.

2.2.2.3 Exterior Finish Coating

Roll coat the finish coating over the primer by roll coating to dry film thickness of 0.80 plus 5 mils for a total dry film thickness of 1.00 plus 0.10 mils. Oven-cure finish coat.

2.2.2.4 Interior Finish Coating

Apply a wash-coat on the reverse side over the primer by roll coating to a dry film thickness of 0.30 plus 0.05 mils for a total dry film thickness of 0.50 plus 0.10 mils. Oven-cure the wash coat.

2.2.2.5 Color

Provide exterior finish color as selected by the COR from the manufacturer's standard color chart for color comparable to specified color in Section 09 06 90 COLOR SCHEDULE.

2.2.2.6 Physical Properties

Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

General: ASTM D 5894 and ASTM D 4587.
Abrasion: ASTM D 968
Adhesion: ASTM D 3359
Chalking: ASTM D 4214

Color Change and Conformity: ASTM D 2244

Flame Spread: ASTM E 84
Flexibility: ASTM D 522
Formability: ASTM D 522
Gloss at 60 and 85 degrees: ASTM D 523
Humidity: ASTM D 2247 and ASTM D 714
Oxidation: ASTM D 610
Pencil Hardness: ASTM D 3363
Reverse Impact: ASTM D 2794
Salt Spray: ASTM B117
Weatherometer: ASTM G 152, ASTM G 153 and ASTM D 822

2.3 FASTENERS

2.3.1 General

2.3.1.1 Exposed Fasteners

Provide corrosion resistant fasteners for wall panels, made of coated steel, aluminum, or nylon capped steel compatible with the sheet panel or flashing and of a type and size recommended by the manufacturer to meet the performance requirements and design loads.

Fasteners for accessories must be the manufacturer's standard. Provide an integral metal washer matching the color of attached material with compressible sealing EPDM gasket approximately 3/32 inch thick.

2.3.1.2 Screws

Screws to be corrosion resistant coated steel, aluminum and/or stainless steel being the type and size recommended by the manufacturer to meet the performance requirements.

2.3.1.3 Attachment Clips

Fabricate clips from steel hot-dipped galvanized in accordance with ASTM A653/A653M, Z275 G 90 or Series 300 stainless steel. Size, shape, thickness and capacity as required meeting the insulation thickness and design load criteria specified.

2.4 ACCESSORIES

2.4.1 General

All accessories must be compatible with the metal wall panels. Sheet metal flashing, trim, metal closure strips, caps and similar metal accessories must not be less than the minimum thickness specified for the wall panels. Exposed metal accessories/finishes to match the panels furnished, except as otherwise indicated.

2.4.2 Rubber Closure Strips

Provide closed-cell, expanded cellular rubber conforming to ASTM D 1056 and ASTM D 1667; extruded or molded to the configuration of the specified wall panel and in lengths supplied by the wall panel manufacturer.

2.4.3 Metal Closure Strips

Provide factory fabricated steel closure strips to be the same gauge, color, finish and profile of the specified wall panel.

2.4.4 Joint Sealants

2.4.4.1 Sealants and Caulking

Provide approved gun type sealants for use in hand- or air-pressure calking guns at temperatures above 4 degrees C (or frost-free application at temperatures above 10 degrees F with minimum solid content of 85 percent of the total volume. Sealants must dry with a tough, durable surface skin which permit remaining soft and pliable underneath, providing a

weather-tight joint. No migratory staining is permitted on painted or unpainted metal, stone, glass, vinyl, or wood.

Prime all joints receiving sealants with a compatible one-component or two-component primer as recommended by the wall panel manufacturer.

2.4.4.2 Field-Applied

Sealant for field-applied caulking must be an approved gun grade, non-sag one component polysulfide or two-component polyurethane with an initial maximum Shore A durometer hardness of 25, and conforming to ASTM C 920, Type II. Color to match panel colors.

2.4.4.3 Pressure Sensitive Tape

Provide pressure sensitive tape sealant, 100 percent solid with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the wall panel manufacturer.

2.5 SHEET METAL FLASHING AND TRIM

2.5.1 Fabrication

Shop fabricate sheet metal flashing and trim where practicable to comply with recommendations in SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

2.6 REPAIR OF FINISH PROTECTION

Repair paint for color finish enameled wall panel must be compatible paint of the same formula and color as the specified finish furnished by the wall panel manufacturer. Provide 2 quarts of aluminized steel repair paint and repair paint matching the specified wall panels.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of the Work.

Examine primary and secondary structural framing to verify that panel support members and anchorages have been installed within alignment tolerances required by metal wall panel manufacturer, UL, ASTM, ASCE 7-10 and as required for the geographical area where construction will take place.

Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

Submit to the COR a written report, endorsed by Installer, listing conditions detrimental to performance of the Work. Proceed with

installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Miscellaneous framing installation and other miscellaneous wall panel support members and anchorage must be according to metal wall panel manufacturer's written instructions.

3.3 WALL PANEL INSTALLATION

Provide full length metal wall panels, from sill to eave as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement in accordance with MBMA MBSM.

Erect wall panel system in accordance with the approved erection drawings, the printed instructions and safety precautions of the manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Bent, chipped, or defective sheets shall not be applied.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the canopy securely anchored, and with the indicated eave, and sill.

Work is to allow for thermal movement of the wall panel, movement of the canopy structure, and to provide permanent freedom from noise due to wind pressure.

Field cutting metal wall panels by torch is not permitted.

3.3.1 Steel Wall Panels

Use corrosive resistant fasteners for exterior surfaces.

3.3.2 Anchor Clips

Anchor metal wall panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.3.3 Metal Protection

Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer.

3.3.4 Joint Sealers

Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.

3.4 FASTENER INSTALLATION

Anchor metal wall panels and other components of the Work securely in

place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.5 FLASHING, TRIM AND CLOSURE INSTALLATION

3.5.1 General Requirements

Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Install work with laps, joints, and seams to form permanently watertight and weather resistant.

Installed sheet metal work is to form weather-tight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades is to be performed by sheet metal mechanics.

3.5.2 Metal Flashing

Install exposed metal flashing at canopy corners, and sills. Exposed metal flashing must be the same material and finish as the specified metal wall panel.

Fasten flashing at a minimum of 8 inches on center, except where flashing is held in place by the same screws that secure covering sheets.

Flashing is to be furnished in at least 8 foot lengths.

Isolate flashing which is in contact with dissimilar metals by means of the specified asphalt mastic material to prevent electrolytic deterioration.

Form drips to the profile indicated, with the edge folded back 1/2 inch to form a reinforced drip edge.

3.5.3 Closures

Install metal closure strips at open ends of corrugated or ribbed pattern walls, and at intersection of wall and wall unless open ends are concealed with formed eave flashing; and in other required areas.

Install mastic closure strips at intersection of the wall with metal walling; top of metal siding; heads of wall openings; and in other required locations.

3.6 WORKMANSHIP

Make lines, arises, and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793.

3.7 ACCEPTANCE PROVISIONS

3.7.1 Erection Tolerances

Erect metal wall panels straight and true with plumb vertical lines correctly lapped and secured in accordance with the manufacturer's written instructions.

3.7.2 Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired with the specified repair materials. Finished repaired surfaces must be uniform and free from variations of color and surface texture.

Repaired metal surfaces that are not acceptable to the project requirements and/or COR are to be immediately removed and replaced with new material.

3.7.3 Paint-Finish Metal Siding

Paint-finish metal siding will be tested for color stability by the COR during the manufacturer's specified guarantee period.

Panels that indicate color changes, fading, or surface degradation, determined by visual examination, must be removed and replaced with new panels at no expense to the Government.

New panels will be subject to the specified tests for an additional year from the date of their installation.

3.8 FIELD QUALITY CONTROL

3.8.1 Construction Monitoring

Make visual inspections as necessary to ensure compliance with specified requirements. Additionally, verify the following:

a. Materials comply with the specified requirements.

b. All materials are properly stored, handled and protected from damage. Damaged materials are removed from the site.

c. Framing and substrates are in acceptable condition, in compliance with specification, prior to application of wall panels.

d. Panels are installed without buckles, ripples, or waves and in uniform alignment and modulus.

e. Side laps are formed, sealed, fastened or seam locked as required.

f. The proper number, type, and spacing of attachment clips and fasteners are installed.

g. Installer adheres to specified and detailed application parameters.

h. Associated flashing and sheet metal are installed in a timely manner in accord with the specified requirements.

Provide three bound copies of Manufacturer's Field Reports to the COR two weeks prior to project close-out.

3.9 CLEAN-UP AND DISPOSAL

Clean all exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from work area. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces must be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

Collect and place scrap/waste materials in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site; transport demolished materials from government property and legally dispose of them.

-- End of Section --

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SECTION 07 51 13.13

COLD-APPLIED BUILT-UP ASPHALT ROOFING

PART 1 GENERAL

1.1 SUMMARY

This section covers aggregate surfaced bituminous built-up roofing, and built-up roofing with granule-surfaced modified bitumen cap sheet on slopes from 1/4 inch to 1-1/2 inch per foot.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM D 146	Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
ASTM D 4586	Asphalt Roof Cement, Asbestos-Free
ASTM D 6163	Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA U1	Use Category System: User Specification for Treated Wood

1.3 DESCRIPTION OF ROOF MEMBRANE SYSTEM

Built-up membrane roofing patch onto existing built-up roofing, cold applied method.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fiberglass Felt Materials

FLASHING MEMBRANE

Adhesives

Cant Strips

Smooth Surface Modified Bitumen Cap Sheet

1.5 QUALITY ASSURANCE

1.5.1 Qualifications of Applicator

The roofing system applicator must have a minimum of 5 years experience as an approved, authorized, or licensed applicator with the manufacturer.

1.5.2 Pre-roofing Conference

After approval of submittals and before performing roofing and insulation system installation work, hold a preroofing conference with the Roofing Contractor and General Contractor, to review the following:

a. Drawings and specifications and submittals related to the roof work;

b. Roof system components installation;

c. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

d. Quality control plan for the roof system installation;

e. Safety requirements.

Coordinate preroofing conference scheduling with the COR. The conference must be attended by the Contractor, the COR's designated personnel, and personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, and other trades interfacing with the roof work. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery

Deliver materials in manufacturers' original unopened containers and rolls with manufacturer's labels intact and legible. Mark and remove wet or damaged materials from site. Where materials are covered by a referenced specification, container must bear specification number, type, and class, as applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.6.2 Storage

Protect materials against moisture absorption, contamination, or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms in dry locations in enclosed buildings or trailers with adequate ventilation. Do not store roll materials in buildings under construction until concrete, mortar, and

plaster work are finished and dry. Do not store materials outdoors unless approved by the COR. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof and yet provide sufficient ventilation to prevent condensation. Maintain roll materials at temperature above 50 degrees F for a 24-hour period immediately prior to application. Place only those materials to be used during one days work on the roof at one time. Remove unused materials from the roof at the end of each days work. Immediately remove wet, contaminated or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the COR.

1.6.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials in the work. Select and operate material handling equipment so as not to damage materials or applied roofing.

1.7 ENVIRONMENTAL CONDITIONS

Do not install roofing during precipitation, or fog, or when air temperature is below 40 degrees F, or when there is ice, frost, moisture or visible dampness on roof deck.

PART 2 PRODUCTS

2.1 GENERAL

Furnish a combination of specified materials that comprise the membrane manufacturer's standard system of the number and type of plies specified. Materials provided must be approved by the roof membrane manufacturer and suitable for the service and climatic conditions of the installation.

2.2 FIBERGLASS FELT MATERIALS

a. Polyester Fiberglass Felt Base Sheet and Ply Felt: ASTM D 146, 28-pound, heavy asphalt coated high tensile trilaminate polyester-fiberglass-polyester base sheet.

2.3 BASE FLASHING MEMBRANE

ASTM D 6163. Membrane manufacturer's standard, minimum two-ply flashing system compatible with the built-up roof membrane and as recommended in membrane manufacturer's published literature.

Flashing Ply: base ply of high temperature high tensile, high elongation polyester flashing membrane, minimum of 35 mils thick.

Flashing Membrane: smooth surface modified bitumen, reinforced polyester, fire retardant flashing cap sheet minimum of 160 mils thick on the selvage edge.

2.4 Adhesives

2.4.1 Cold-applied Adhesive

One-part, asbestos-free, cold-applied bituminous adhesive specially formulated for compatibility and used with specified roofing membranes and flashings as recommended by roofing manufacturer.

a. Tremco Burmastic Adhesive LV or approved equal.

2.4.2 Waterproofing Roof Mastic

Provide trowel grade asphalt-based mastic blended with penetrating oils and plasticizing agents. Asbestos free and complies with ASTM D 4586, Type II, Class I. Used for adhering modified bitumen membrane flashings.

a. Tremco ELS or approved equal.

2.5 SURFACING MATERIAL

2.5.1 Smooth Surface Modified Bitumen Cap Sheet

ASTM D 6163; Type II, Grade G, minimum 3 mm (120 mils) thick at selvage edge, and as required to provide specified fire safety rating.

2.6 CANT STRIPS

Douglas Fir or Southern Pine, No. 2 grade. Free from warping and visible decay; pressure-treated with chromated copper arsenate (CCA) to meet AWPA U1, 0.25 retention and marked, or use California approved insect resistant treated wood.

2.7 ROSIN-SIZED BUILDING PAPER

Provide rosin-sized sheathing paper weighing minimum 5 pounds per 100 square feet.

2.8 FASTENERS

Coated, corrosion resistant fasteners compatible with components being attached and contact surfaces.

2.8.1 Wood Substrates and Nailers

Provide 11 gage annular threaded shank nails with 7/16 to 5/8 inch diameter heads; or one-piece composite nails with annular threaded shanks not less than 11 gage for securing metal items. Provide fasteners long enough to penetrate minimum 1-1/4 inch into wood substrate materials. Do not penetrate wood decking exposed to view on the underside.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Before applying roofing materials, ensure that the following exist:

a. Curbs, cants, roof penetrating components, and equipment supports are in place.

b. Surfaces are rigid, clean, dry, smooth, and free of cracks, holes, and sharp changes in elevation. Joints in substrate are sealed to prevent drippage of bitumen into building or down exterior walls. Inspect surfaces and approve immediately before application of roofing and flashings. Apply the roofing and flashings to a smooth and firm surface free from ice, frost, visible moisture, dirt, projections, and foreign materials.

c. The plane of the substrate does not vary more than 1/4 inch within an area 10 by 10 feet when checked with a 10 foot straight edge placed anywhere on the substrate.

d. Substrate is sloped as indicated to provide drainage.

e. Walls and vertical surfaces are constructed to receive counterflashing and will permit mechanical fastening of the base flashing materials.

h. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is approximately 45 degrees and the height of the vertical leg is not less than nominal 3-1/2 inch. Lay cants in a solid coat of adhesive just prior to laying the roofing plies.

3.2 PREPARATION

Verify that work of other trades that penetrates the roof deck or requires men and equipment to traverse the roof deck is complete.

Examine deck surfaces for inadequate anchorage, foreign material, moisture, and unevenness which would prevent the execution and quality of application.

Proceed with the roofing application only after defects have been corrected.

Starting work designates acceptance of the surfaces by the Contractor.

3.2.1 Covering of Wood Substrate

Cover wood substrate with a layer of rosin-sized building paper lapped 2 inch at sides and 4 inch at ends. Nail to hold in place prior to application of roofing system.

3.3 Cant Strips

Install cant strips at intersections of roofing and vertical surfaces. Butt joints and miter corners, and lay true to line. Embed in a continuous bed of approved adhesive.

3.4 APPLICATION

Apply roofing materials as specified unless approved otherwise by the COR. Keep roofing materials dry before and during application. Complete application of roofing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day. Maintain specified temperature for asphalt.

3.4.1 Phased Membrane Construction

Phased application of membrane plies is prohibited.

3.4.2 Base Sheet Application - General

Fully adhere base sheets in accordance with membrane manufacturer's printed instructions. Roll and broom in the base sheet to ensure full contact with the adhesive application. Apply sheets in a continuous operation. Apply sheets with side laps at a minimum of 4 inch unless greater side lap is recommended by the manufacturer's standard written application

instructions. Provide end laps of not less than 6 inch and staggered a minimum of 36 inch. Apply sheets at right angles to the roof slope so that the direction of water flow is over and not against the laps. Extend base sheets to the top of cant strips. Trim base sheet to a neat fit around vent pipes, and other projections through the roof. Application must be free of ridges, wrinkles, and buckles.

Cold-applied adhesive rate: 3 gallons per 100 sq. ft.

3.4.3 Ply Felts

Ensure proper alignment of felts prior to installation. Apply two (2) plies shingle fashion perpendicular to slope of roof, to substrate and all wall, curb and projection bases in a uniform and continuous mopping of cold adhesive.

Overlap starter strips 20 inches with first ply, then overlap each succeeding ply 19 inches. Place ply sheets to ensure water will flow over or parallel to, but never against exposed edges. Use 18 and 36 inch wide plies to start and finish roof membrane along roof edges and terminations. Ensure complete and continuous seal and contact between adhesive and ply sheets, including ends, edges, and laps without wrinkles, fish mouth, or blisters. Roofing membrane shall never touch roofing membrane, even at roof edges, laps, tapered edge strips and cants. Cut out fish mouths and side laps that are not completely sealed, and patch. Replace all sheets that are not fully and continuously bonded. Lap ply membrane ends 4 inches. Stagger end laps 3 feet minimum.

Cold-applied adhesive rate: 3 gallons per 100 sq. ft.

Install all specified penetration flashing flanges and strip in with 18-inch and 12-inch stripping plies.

Extend felts to top of cant strips.

3.4.4 Smooth-Surfaced Modified Bitumen Cap Sheet

Inspect underlying applied membrane and repair free of damage, holes, puncture, gouges, abrasions, and any other defects, and free of moisture, loose materials, debris, sediments, dust, and any other conditions required by the membrane manufacturer prior to cap sheet installation. When delays in cap sheet installation may have occurred, do not apply cap sheet if underlying materials have been exposed to rain or frozen precipitation within the previous 24 hours. Unroll cap sheet membrane and allow to relax a minimum of 30 minutes prior to installation unless otherwise recommended by the membrane manufacturer.

Apply cap sheet in same direction as the underlying felt plies. Offset cap sheet laps from ply felts 6-inch minimum. Apply uniform and continuous pressure to selvage and end laps to ensure complete adhesion. Lap sheet ends 6-inches, stagger end laps 36-inches minimum. Ensure complete and continuous seal and contact between adhesive and membrane, including ends, edges, and laps without wrinkles, fish mouths, or blisters. Avoid walking on membrane until adhesive has set. Embed membrane in a uniform and continuous mopping of adhesive.

Cold-applied adhesive rate: 3 gallons per 100 sq. ft.

3.4.5 Membrane Flashing

Install base flashing membrane where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, and where necessary to make the work watertight. Top ply of flashing must be smooth-surfaced modified bitumen membrane.

Adhere flashing ply in a continuous application of waterproofing roof mastic. Remove wrinkles and voids. Overlap sections 6 inches. Extend flashing ply 4 inches beyond toe of cant. Cut flashing ply in lengths not to exceed 10 feet. Apply waterproofing roof mastic to flashing ply in a continuous application. Adhere flashing membrane to waterproofing roof mastic. Lap flashing membrane ends 4 inches; extend membrane 6 inches beyond edge of flashing ply; press sheet firmly in place. Ensure complete bond and continuity without wrinkles or voids.

3.4.6 Correction of Deficiencies

Where any form of deficiency is found, take additional measures to determine the extent of the deficiency and corrective actions must be as directed by the COR. Where free water, skips, excessive voids, dry laps, desponding or any form of delamination are discovered between the plies, remove and rebuild affected area. Correction of inadequate number of plies, improper lap widths, or non-uniform or excessive adhesive must be as directed by the COR.

3.4.7 Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.5 FIELD QUALITY CONTROL

Perform field tests in the presence of the COR. Notify the COR one day before performing tests.

3.5.1 Test for Surface Dryness

Before application of membrane materials and starting work on the area to be roofed, perform test for surface dryness.

3.5.2 Construction Monitoring

During progress of the roof work, Contractor is responsible for making visual inspections to ensure compliance with specified parameters. Additionally, verify the following:

a. Equipment is in working order.

b. Materials are not installed in adverse weather conditions.

c. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

d. Nailers and blocking are provided where and as needed.

e. The proper number, type, and spacing of fasteners are installed.

f. Materials comply with the specified requirements.

g. All materials are properly stored, handled and protected from moisture or other damages.

h. The proper number and types of plies are installed, with the specified overlaps.

i. Applied membrane surface is inspected, cleaned, dry, and repaired as necessary prior to cap sheet installation.

j. Membrane is without ridges, wrinkles, kinks, fishmouths, or other voids or delaminations.

k. Installer adheres to specified and detailed application parameters.

l. Associated flashing manner in accord with the specified requirements.

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SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 GENERAL

1.1 SUMMARY

This section covers flashing and sheet metal work including gutters and downspouts, scuppers, splash pans, and sheet metal roofing.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 32	Standard Specification for Solder Metal
ASTM D 4586	Asphalt Roof Cement, Asbestos-Free
ASTM D41/D41M	Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	Architectural Sheet Metal Manual, 6th Edition

1.3 GENERAL REQUIREMENTS

Finished sheet metalwork will form a weathertight construction without waves, warps, buckles, fastening stresses or distortion, which allows for expansion and contraction. Sheet metal mechanic is responsible for cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing with roofing work to permit continuous roofing operations.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Gutters

Downspouts

Counterflashing

Flashing at roof penetrations

Canopy Vent and Stack Umbrella Flashing

Indicate thicknesses, dimensions, fastenings and anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

1.5 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. Provide accessories made of the same or compatible materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Provide sheet metal items with mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used except as follows:

2.1.1 Exposed Sheet Metal Items

Must be of the same material. Consider the following as exposed sheet metal: gutters, including hangers; downspouts; and related accessories.

2.1.2 Lead Sheet

Minimum weight 4 pounds per square foot.

2.1.3 Steel Sheet, Zinc-Coated (Galvanized)

ASTM A653/A653M, with 1.25 oz/sq.ft.(G90) galvanizing.

2.1.4 Stainless Steel

ASTM A167, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.1.5 Draw band and Sealants

Draw band: stainless steel worm gear type.

Draw band sealant: moisture curing tubed urethane sealant, asphalt compatible.

Sheet metal joint sealant: polyurethane.

2.1.6 Solder

ASTM B 32, 95-5 tin-antimony, neutralize flux after soldering.

Solder for stainless steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

2.1.7 Bituminous Plastic Cement

ASTM D 4586, Type I.

2.1.8 Asphalt Primer

ASTM D41/D41M.

2.1.9 Fasteners

Use the same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Workmanship

Make lines and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.1.2 Nailing

Confine nailing of sheet metal generally to sheet metal having a maximum width of 18 inch. Confine nailing of flashing to one edge only. Space nails evenly not over 3 inch on center and approximately 1/2 inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work.

3.1.3 Cleats

Provide cleats for sheet metal 18 inch and over in width. Space cleats evenly not over 12 inch on center unless otherwise specified or indicated. Unless otherwise specified, provide cleats of 2 inch wide by 3 inch long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. Where the fastening is to be made to concrete or masonry, use screws and drive in expansion shields set in concrete or masonry. Pretin cleats for soldered seams.

3.1.4 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection.

3.1.5 Soldering

Where soldering is specified, apply to zinc-coated steel, and stainless steel items. Pretin edges of sheet metal before soldering is begun. Do not solder aluminum.

3.1.5.1 Edges

Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux the edges of stainless steel to be pretinned. Do not solder aluminum.

3.1.6 Protection from Contact with Dissimilar Materials

3.1.6.1 Copper or Copper-bearing Alloys

Paint with heavy-bodied bituminous paint surfaces in contact with dissimilar metal, or separate the surfaces by means of moistureproof building felts.

3.1.6.2 Aluminum

Do not allow aluminum surfaces in direct contact with other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.

3.1.6.3 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal

with a coat of heavy-bodied bituminous paint.

3.1.7 Counterflashing

Except where indicated or specified otherwise, insert counterflashing located from 9 to 10 inch above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 3 inch. Fold the exposed edges of counterflashings 1/2 inch. Where stepped counterflashings are required, they may be installed in short lengths a minimum 8 inch by 8 inch or may be of the preformed one-piece type. Provide end laps in counterflashings not less than 3 inch and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 10 feet. Form the flashings to the required shapes before installation. Factory-form the corners not less than 12 inch from the angle. Secure the flashings in the reglets with lead wedges and space not more than 18 inch apart; on short runs, place wedges closer together.

Install counterflashing to provide a spring action against base flashing. Where bituminous base flashings are provided, extend down the counter flashing as close as practicable to within 1 inch above the top of the cant strip. Factory form counter flashing to provide spring action against the base flashing.

3.1.8 Gutters

The hung type of shape indicated and supported on underside by brackets that permit free thermal movement of the gutter. Provide gutters in sizes indicated complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Bead with hemmed edge or reinforce the outer edge of gutter with a stiffening bar not less than 3/4 by 3/16 inch of material compatible with gutter. Fabricate gutters in sections not less than 8 feet. Lap the sections a minimum of one inch in the direction of flow or provide with concealed splice plate 6 inch minimum. Join the gutters, other than aluminum, by riveted and soldered joints. Join aluminum gutters with riveted sealed joints. Provide expansion-type slip joints midway between outlets. Install gutters below slope line of the roof so that snow and ice can slide clear. Support gutters on by cleats spaced not less than 36 inch apart. Adjust gutters to slope uniformly to outlets, with high points occurring midway between outlets. Fabricate hangers and fastenings from metals.

3.1.9 Downspouts

Space supports for downspouts according to the manufacturer's recommendation for the steel substrate. Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 10 foot lengths. Provide end joints to telescope not less than 1/2 inch and lock longitudinal joints. Provide gutter outlets with wire ball strainers for each outlet. Provide strainers to fit tightly into outlets and be of the same material used for gutters. Keep downspouts not less than one inch away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 5 feet on center with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

3.1.9.1 Terminations

Neatly fit into the drainage connection the downspouts terminating in drainage lines and fill the joints with a portland cement mortar cap sloped

away from the downspout.

3.1.10 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, and similar items supported by or attached to the roof deck.

3.1.11 Canopy Vent and Stack Umbrella Flashing

Where shown on drawings, fabricate umbrella flashing from stainless steel sheets of gage and hidden reinforcing ribs as required for spans and sizes as shown. Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux to a width of 1-1/2 inches. Promptly wash off acid flux residue from metal after soldering.

3.2 PAINTING

Field-paint sheet metal for separation of dissimilar materials.

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.5 FIELD QUALITY CONTROL

Remove work that is not in compliance with the contract and replace or correct. Include quality control, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification that specified material is provided and installed.

c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

3.5.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the COR at the end of each day.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES
(General Table and not all items may be used or specified)

Sheet Metal Items	Copper, Ounces Per Square Foot	Aluminum, Inch	Stainless Steel, Inch	Terne-Coated Steel, Inch	Zinc-Coated Steel, U.S. Std. Gage
Building Expansion Joints					
Cover	16	.032	.015	.015	24
Waterstop-bellows or flanged, U-type.	16	-	.015	.015	-
Covering on minor flat, pitched or curved surfaces	20	.040	.018	.018	-
Downspouts and leaders	16	.032	.015	.015	24
Downspout clips and anchors	-	.040 clip	-	-	-
	-	.125 anchor	-	-	-
Downspout straps, 2-inch	48(a)	.060	.050	-	-
Conductor heads	16	.032	.015	.015	-
Scupper lining	20	.032	.015	.015	-
Strainers, wire diameter or gage	No. 9 gage	.144 diameter	.109 diameter		-
Flashings:					
Base	20	.040	.018	.018	24
Cap (Counter-flashing)	16	.032	.015	.015	26
Eave	16	-	.015	.015	24
Spandrel beam	10	-	.010	.010	-
Bond barrier	16	-	.015	.015	-
Stepped	16	.032	.015	.015	-
Valley	16	.032	.015	.015	-
Roof drain	16(b)				
Pipe vent sleeve(d)					
Coping	16	-	-	-	-
Gravel stops and fascias:					
Extrusions	-	.075	-	-	-
Sheets, corrugated	16	.032	.015	.015	-
Sheets, smooth	20	.050	.018	.018	24
Edge strip	24	.050	.025	-	-
Gutters:					
Gutter section.....	16	.032	.015	.015	24
Continuous cleat.....	16	.032	.015	.015	24
Hangers, dimensions	1 inch by 1/8 inch (a)	1 inch by .080 inch (c)	1 inch by .037 inch	-	-

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES
(General Table and not all items may be used or specified)

Sheet Metal Items	Copper, Ounces Per Square Foot	Aluminum, Inch	Stainless Steel, Inch	Terne-Coated Steel, Inch	Zinc-Coated Steel, U.S. Std. Gage
Joint Cover plates... (See Table II)	16	.032	.015	.015	24
Reglets (c)	10	-	.010	.010	-
Splash pans	16	.040	.018	.018	-

(a) Brass.

(b) May be lead weighing 4 pounds per square foot.

(c) May be polyvinyl chloride.

(d) 2.5 pound minimum lead sleeve with 4 inch flange. Where lead sleeve is impractical, refer to paragraph entitled "Single Pipe Vents" for optional material.

TABLE II. SHEET METAL JOINTS
(General Table and not all items may be used or specified)

Item Designation	Copper, Terne-Coated Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Joint cap for building expansion seam, cleated joint at roof	1.25 inch single lock, standing seam, cleated	1.25 inch single lock, standing	- - -
Flashings			
Base	One inch 3 inch lap for expansion joint	One inch flat locked, soldered; sealed; 3 inch lap for expansion joint	Aluminum producer's recommended hard setting sealant for locked aluminum joints. Fill each metal expansion joint with a joint sealing compound compound.
Cap-in	3 inch lap	3 inch lap	Seal groove with

TABLE II. SHEET METAL JOINTS
(General Table and not all items may be used or specified)

Item Designation	Copper, Terne-Coated Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
reglet			joint sealing compound.
Reglets	Butt joint	- - -	Seal reglet groove with joint sealing compound.
Eave	One inch flat locked, cleated One inch loose locked, expansion joint cleated	One inch flat locked, locked, cleated one inch loose locked, sealed expansion joints, cleated	Same as base flashing.
Stepped	3 inch lap	3 inch lap	- - -
Valley.	6 inch lap cleated	6 inch lap cleated	- - -
Edge strip	Butt	Butt	- - -
Gravel stops:			
Extrusions	- - -	Butt with 1/2 inch space	Use sheet flashing beneath and a cover plate.
Sheet, smooth	Butt with 1/4 inch space	Butt with 1/4 inch space	Use sheet flashing backup plate.
Sheet corrugated	Butt with 1/4 inch space	Butt with 1/4 inch space	Use sheet flashing beneath and a cover plate or a combination unit
Gutters	1.5 inch lap, riveted and soldered	One inch flat locked, riveted, and sealed	Aluminum producers recommended hard setting sealant for locked aluminum joints.

(a) Provide a 3 inch lap elastomeric flashing with manufacturer's recommended sealant.

(b) Seal polyvinyl chloride reglet with manufacturer's recommended sealant.

TABLE II. SHEET METAL JOINTS
(General Table and not all items may be used or specified)

Item Designation	Copper, Terne-Coated Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks

-- End of Section --

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SECTION 07 92 00

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SECTION 07 92 00

JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

This section covers sealants for normal building construction.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM C 920	Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealants

Primers

Bond breakers

Backstops

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). Provide a copy of the Material Safety Data Sheet for each solvent, primer or sealant material.

SD-07 Certificates

Sealant

Certificates of compliance stating that the materials conform to

the specified requirements.

1.4 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

1.5 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 90 degrees F or less than 0 degrees F.

1.6 QUALITY ASSURANCE

1.6.1 Compatibility with Substrate

Verify that each of the sealants are compatible for use with joint substrates.

1.6.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied. Comply with applicable regulations regarding toxic and hazardous materials, and as specified. Sealants containing asbestos, aromatic solvents, fibrous talc, formaldehyde, halogenated solvents, mercury, lead, cadmium, chromium and their compounds, are not permitted. Sealants, primers, and cleaners required for sealant installation must also comply with all local regulations controlling VOC content.

2.1.1 Interior Sealant, Acrylic Latex

One-part mildew resistant, silicone rubber conforming to ASTM C 920, Type S, Grade NS, Class 2.5, Use NT. Color shall match surrounding material unless indicated otherwise. Location(s) and color(s) of sealant for the following:

	LOCATION	COLOR
a.	Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface-mounted equipment and fixtures, and similar items.	White
b.	Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	White
c.	Joints of interior masonry walls and partitions which adjoin columns, pilasters,	White

LOCATION	COLOR
concrete walls, and exterior walls unless otherwise detailed.	
d. Joints between edge members for acoustical tile and adjoining vertical surfaces.	White
e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	White

2.1.2 Interior Sealant, Silicone Rubber Based

Provide ASTM C 920, Type S, Grade NS, Class 25. Location(s) and color(s) of sealant for the following:

LOCATION	COLOR
a. Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where nonplaner tile surfaces meet.	White
b. Joints between tile and dissimilar materials; joints occurring where substrates change.	White
c. Behind escutcheon plates at valve pipe penetrations and showerheads in showers and around plumbing fixtures.	White

2.1.3 Exterior Sealant

For joints in vertical surfaces, provide elastomeric type conforming to ASTM C 920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

LOCATION	COLOR
a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	Match adjacent surface color
b. Voids where items pass through exterior walls.	Match adjacent surface color
c. Metal-to-metal joints where sealant is indicated or specified.	Match adjacent surface color
d. Joints between ends of gravel stops, fascias, copings, and adjacent walls.	Match adjacent surface color

For joints at high temperature locations (up to 250-degrees Fahrenheit), provide low-modulus silicone type as recommended by manufacturer conforming to ASTM C 920, Type S, Grade NS, Class 100/50, Use NT. Provide location

and color of sealant as follows:

LOCATION	COLOR
e. Joints and recesses formed between flashing and high temperature vents and/or exhaust flues. Tremco Spectrem 1 or approved equal.	Gray

2.1.4 Floor Joint Sealant

Provide elastomeric type conforming to ASTM C 920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

LOCATION	COLOR
a. Seats of metal thresholds for exterior doors.	Gray
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.	black

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular type of sealant and application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.4 BACKSTOPS

Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Make backstop material compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

2.4.1 Rubber

Conform to ASTM D 1056, Type 2, closed cell, Class A, round cross section for cellular rubber sponge backing.

2.4.2 Neoprene

Conform to ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 for Neoprene backing.

2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer except for aluminum and bronze surfaces that will be in contact with sealant.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean surfaces from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, contact sealant manufacturer for specific recommendations.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.1.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.1.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity.

3.1.4 Wood Surfaces

Keep wood surfaces to be in contact with sealants free of splinters and sawdust or other loose particles.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH Minimum	JOINT DEPTH Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width

JOINT WIDTH	JOINT DEPTH Minimum	Maximum
For wood, concrete, masonry, stone, or :		
1/4 inch (minimum)	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 2 inch	1/2 inch	5/8 inch
Over 2 inch.	(As recommended by sealant manufacturer)	

b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is not required on metal surfaces.

3.3.2 Masking Tape

Place masking tape on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Remove masking tape within 10 minutes after joint has been filled and tooled.

3.3.3 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

a. Where indicated.

b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios".

3.3.4 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous and non-porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.5 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.6 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in

accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Make sealant uniformly smooth and free of wrinkles.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

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DIVISION 08 - OPENINGS

SECTION 08 11 13

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SECTION 08 11 13

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

This section covers steel doors and frames.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A879/A879M	Standard Specification for Steel Sheet, zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
ASTM A924/A924M	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C 612	Mineral Fiber Block and Board Thermal Insulation
ASTM D 2863	Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.115	Hardware Preparation in Steel Doors and Steel Frames

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR 111	Recommended Selection and Usage Guide for Standard Steel Doors, Frames and Accessories
SDI/DOOR 113	Standard Practice for Determining the Steady State Thermal Transmittance of Steel Door and Frame Assemblies
SDI/DOOR A250.11	Recommended Erection Instructions for Steel Frames
SDI/DOOR A250.6	Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
SDI/DOOR A250.8	Recommended Specifications for Standard Steel Doors and Frames

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors

Frames

Accessories

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors

Schedule of frames

Submit door and frame locations.

SD-03 Product Data

Doors

Frames

Accessories

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI/DOOR A250.8 requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware as specified in Section 08 71 00. Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1-3/4 inch thick, unless otherwise indicated.

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Extra Heavy Duty Doors

SDI/DOOR A250.8, Level 3, physical performance Level A, Model 2 with core construction as required by the manufacturer for interior doors and for indicated exterior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation.

2.2 ACCESSORIES

2.3 INSULATION CORES

Insulated cores shall be of type specified, and provide an apparent U-factor of .48 in accordance with SDI/DOOR 113 and shall conform to:

a. Rigid Cellular Polyisocyanurate Foam: ASTM C 591, Type I or II, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D 2863; or

b. Rigid Polystyrene Foam Board: ASTM C 578, Type I or II; or

c. Mineral board: ASTM C 612, Type I.

2.4 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 3 , except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners.

2.4.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

Weld frames in accordance with the recommended practice of the Structural Welding Code Sections 1 through 6, AWS D1.1/D1.1M and in accordance with the practice specified by the producer of the metal being welded.

2.4.2 Stops and Beads

Form stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inch on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.4.3 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage.

2.4.3.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

a. Masonry: Provide expansion anchors with pipe sleeves for installation at existing masonry walls;

b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to wood studs with nails, to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;

c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111.

2.4.3.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member. Where floor fill occurs, terminate bottom of frames at the indicated finished floor levels and support by adjustable extension clips resting on and anchored to the structural slabs.

2.5 WEATHERSTRIPPING

As specified in Section 08 71 00 DOOR HARDWARE.

2.6 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in SDI/DOOR A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI/DOOR A250.8 and SDI/DOOR A250.6. For additional requirements refer to ANSI/BHMA A156.115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI/DOOR A250.8, as applicable. Punch door frames, with the exception of frames that will have weatherstripping gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.7 FINISHES

2.7.1 Factory-Primed Finish

All surfaces of interior doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in SDI/DOOR A250.8, or paintable A25 galvannealed steel without primer. Where coating is removed by welding, apply touchup of factory primer.

2.7.2 Hot-Dip Zinc-Coated Finish

Fabricate exterior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A924/A924M and ASTM A653/A653M. The coating weight shall meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot, total both sides, i.e., A40. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI/DOOR A250.8. Provide for exterior doors.

2.7.3 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with ASTM A879/A879M, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI/DOOR A250.8.

2.8 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Design other frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive calking compound.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean

thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

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SECTION 08 14 00

WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

This section covers wood doors.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 1-A	Architectural Wood Flush Doors
WDMA I.S. 4	Water-Repellent Preservative Non-Pressure Treatment for Millwork

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Doors

Accessories

Water-resistant sealer

Sample warranty

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 4 inch thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Replace defective or damaged doors with new ones.

1.5 WARRANTY

Warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

PART 2 PRODUCTS

2.1 DOORS

Provide doors of the types, sizes, and designs specified free of urea-formaldehyde resins.

2.1.1 Flush Doors

Conform to WDMA I.S. 1-A for flush doors. Provide hollow core doors with lock blocks and 1 inch minimum thickness hinge stile.

2.1.1.1 Interior Flush Doors

Provide particleboard core, Type II flush doors conforming to WDMA I.S. 1-A with faces of sound grade hardwood or hardboard for painted finish.

2.2 ACCESSORIES

2.2.1 Door Louvers

Fabricate from metal, 12 inches by 24 inches, and locate 12 inches from bottom of door. Provide louvers with a minimum of 35 percent free air. Equip louvers with slat type. Mount louvers in the door with flush metal frames.

2.2.2 Additional Hardware Reinforcement

Provide the minimum lock blocks to secure the specified hardware. The measurement of top, bottom, and intermediate rail blocks are a minimum 125 mm 5 inch by full core width. Comply with the manufacturer's labeling requirements for reinforcement blocking, but not mineral material similar to the core.

2.3 FABRICATION

2.3.1 Quality and Construction

Identify the standard on which the construction of the door was based, identify the standard under which preservative treatment was made, and identify doors having a Type I glue bond.

2.3.2 Preservative Treatment

Treat doors scheduled for restrooms, janitor closets and other possible wet locations including exterior doors with a water-repellent preservative treatment and so marketed at the manufacturer's plant in accordance with WDMA I.S. 4.

2.3.3 Adhesives and Bonds

WDMA I.S. 1-A. Use Type I bond for exterior doors and Type II bond for interior doors. Provide a nonstaining adhesive on doors with a natural finish.

2.3.4 Finishes

2.3.4.1 Field Painting

Factory prime or seal doors for field painting by others.

2.3.5 Water-Resistant Sealer

Provide manufacturer's standard water-resistant sealer compatible with the specified finish.

PART 3 EXECUTION

3.1 INSTALLATION

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 1/16 inch minimum, 1/8 inch maximum clearance at sides and top, and a 3/16 inch minimum, 1/4 inch maximum clearance over thresholds. Provide 3/8 inch minimum, 7/16 inch maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 1/8 inch in 2 inch. Door warp shall not exceed 1/4 inch when measured in accordance with WDMA I.S. 1-A.

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SECTION 08 71 00

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

This section covers finish hardware for permanent structures.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM E 283	Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1	Butts and Hinges
ANSI/BHMA A156.13	Mortise Locks & Latches Series 1000
ANSI/BHMA A156.16	Auxiliary Hardware
ANSI/BHMA A156.18	Materials and Finishes
ANSI/BHMA A156.2	Bored and Preassembled Locks and Latches
ANSI/BHMA A156.21	Thresholds
ANSI/BHMA A156.22	Door Gasketing and Edge Seal Systems
ANSI/BHMA A156.3	Exit Devices
ANSI/BHMA A156.4	Door Controls - Closers
ANSI/BHMA A156.6	Architectural Door Trim
ANSI/BHMA A156.7	Template Hinge Dimensions

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8	Recommended Specifications for Standard

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Hardware schedule

Keying system

SD-03 Product Data

Hardware items

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Key Bitting

1.4 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (If fire rated and listed)	BHMA Finish Designation

1.5 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the COR prior to completion of the work. Include:

a. Complete listing of all keys (AA1, AA2, etc.).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

1.6 QUALITY ASSURANCE

1.6.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.6.2 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the COR, Contractor, Door Hardware subcontractor, using Activity and Base Locksmith shall meet to discuss key requirements for the facility.

1.6.3 Electronic Security System

Coordinate with Section 28 20 01.00 10 ELECTRONIC SECURITY SYSTEM.

1.7 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the COR, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Provide hardware to be applied to metal manufactured to template. Promptly furnish template information or templates to door and frame manufacturers. Conform to ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.2.1 Hinges

ANSI/BHMA A156.1, 4-1/2 by 4-1/2 inch unless otherwise indicated. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Provide heavy-weight, ball-bearing, button tip hinges.

Type A2111, unless otherwise scheduled.

2.2.2 Locks and Latches

2.2.2.1 Mortise Locks and Latches

ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with escutcheons not less than 7 by 2-1/4 inch with a bushing at least 1/4 inch long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides,

corners, and edges. Install knobs and roses of mortise locks with screwless shanks and no exposed screws.

Best 45HW, Electrified Mortise Locks as specified, NO SUBSTITUTIONS

2.2.2.2 Bored Locks and Latches

ANSI/BHMA A156.2, Series 4000, Grade 1.

Best 9K, Heavy Duty Locks as specified, NO SUBSTITUTIONS.

2.2.3 Exit Devices

ANSI/BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices.

Von Duprin 33A type as specified. NO SUBSTITUTIONS.

2.2.4 Cylinders and Cores

Provide cylinders and cores with seven pin tumblers. Provide cylinders and cores from Best Access Systems, 1E Series Cylinders. NO SUBSTITUTIONS. Rim cylinders, mortise cylinders, and knobs of bored locksets have interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

2.2.5 Keying System

Provide an extension of the existing keying system.

2.2.6 Lock Trim Knobs and Roses

Cast, forged, or heavy wrought construction and commercial plain design.

Provide Best 15D, unless otherwise specified. NO SUBSTITUTION.

2.2.7 Keys

Furnish one file key, one duplicate key, and one working key for each key change. Furnish one additional working key for each lock of each keyed-alike group. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

2.2.8 Closers

ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers, except at storefront mounting, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

Provide LCN as specified under Hardware Sets, or equivalent by Sargent. NO SUBSTITUTIONS permitted.

2.2.8.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

2.2.9 Door Protection Plates

ANSI/BHMA A156.6.

2.2.9.1 Sizes of Kick Plates

2 inch less than door width for single doors; one inch less than door width for pairs of doors. Provide 8 inch kick plates for flush doors.

2.2.10 Door Stops and Silencers

ANSI/BHMA A156.16.

Silencers Type L03011: provide three silencers for each single door, two for each pair.

Wall Bumper Type: L02251

Floor Stop Type: L02141, or L02161 at doors with thresholds.

2.2.11 Thresholds

ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.2.12 Weather Stripping Gasketing

ANSI/BHMA A156.22. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule". Provide a set to include head and jamb seals, sweep strips. Air leakage of weather stripped doors not to exceed 0.5 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283. Provide weather stripping with one of the following:

2.2.12.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide clear (natural) anodized aluminum.

2.2.13 Rain Drips

Extruded aluminum, not less than 0.08 inch thick, bronze anodized. Set drips in sealant and fasten with stainless steel screws.

2.2.13.1 Door Rain Drips

Approximately 1-1/2 inch high by 5/8 inch projection. Align bottom with bottom edge of door.

2.2.13.2 Overhead Rain Drips

Approximately 1-1/2 inch high by 2-1/2 inch projection, with length equal

to overall width of door frame. Align bottom with door frame rabbet.

2.2.14 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.2.15 Armored Door Cord

18 inch stainless steel flexible cord with metal end caps.

2.2.16 Magnetic Door Contact

Recessed type into door frame unless otherwise scheduled, GE Sentrol 1070. NO SUBSTITUTION.

2.2.17 Power Supply

Coordinate with Owner to utilize existing power supply cabinets, Lenel AL1012ULX (12 VDC) and Lenel AL1024ULX (VDC) as noted, and provide new Lenel and Von Duprin power supplies as scheduled.

2.3 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Provide stainless steel or nonferrous metal fasteners that are exposed to weather. Provide fasteners of type necessary to accomplish a permanent installation.

2.4 FINISHES

ANSI/BHMA A156.18.

Provide hardware in BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except aluminum paint finish for surface door closers.

Provide hinges in stainless steel with BHMA 630 finish.

Furnish exit devices in BHMA 626 finish in lieu of BHMA 630 finish except where BHMA 630 is specified under paragraph entitled "Hardware Sets".

Match exposed parts of concealed closers to lock and door trim. Match hardware finish for aluminum doors to the doors.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed installation instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping to prevent damage. Provide full contact, weather-tight seals. Operate doors without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 9 inch on center after doors and frames have been finish painted.

3.1.2 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.2 HARDWARE LOCATIONS

SDI/DOOR A250.8, unless indicated or specified otherwise.

a. Kick Plates: Push side of single-acting doors.

3.3 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the COR. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the COR. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.4 HARDWARE SETS

Provide:

HW-1

3 Hinges	
1 Privacy lock	Best 93K7L x 626
1 Kickplate	
1 Wall bumper	

HW-2

3 Hinges	
1 Armored door cord	
1 Electrified lockset	Best 45HW7DEU x 15J x 626
1 Mortise cylinder	
1 Magnetic contact	
1 Card reader	Specified by Electrical
1 Power supply	Use existing Lenel
1 Closer	LCN 4040XP-CUSH
1 Overhead rain drip	
1 Door rain drip	
1 Set weatherstripping	
1 Threshold	

HW-3

6 Hinges	
2 Armored door cord	

	2 Magnetic contacts	Provide surface mounted similar to existing
	1 Rim device	Von Duprin EL-RX3327A-L x 360L-03 x RG-27
	1 Mortise cylinder	
	1 Rim device	Von Duprin RX3327A-EO x RG-27
	2 Closers	LCN 4040XP-CUSH
	1 Card reader	Specified by Electrical
	1 power supply	Von Duprin PS 914-2RS
	2 Silencers	
HW-4		
	3 Hinges	
	1 Armored door cord	
	1 Electrified lockset	Best 45HW7WEU x 15J x 626
	2 Card readers	Specified by Electrical
	1 Magnetic contact	Provide surface mounted similar to existing
	1 Power supply	Use existing Lenel
	1 Closer	LCN 4040XP-CUSH
	1 Overhead rain drip	
	1 Door rain drip	
	1 Set weatherstripping	
	1 Threshold	
HW-5		
	1 Card reader	Specified by Electrical
	2 Armored door cord	
	1 Power supply	Von Duprin PS214-2RS
	1 rim device	Von Duprin EL-RX3327A-L X 360L-03 X RG-27
	1 mortise cylinder	
	1 powered operator	LCN 4642
	1 rim device	Von Duprin RX3327A-EO x RG-27
	1 closer	LCN 4040XP-CUSH
	1 ADA push plate	LCN 8310-853T (interior surface mounted)
HW-6		
	3 hinges	Specified in Section 10 22 13
	1 armored door cord	
	1 electrified lock	Best 93KW7DEU x 626
	1 card reader	Specified by Electrical
	1 power supply	Use existing Lenel
HW-7		
	6 hinges	Specified in Section 10 22 13
	1 Exit function lock	Best 93K7NX x 626
HW-8		
	3 hinges	Specified by Civil
	1 lock case	Specified by Civil
	1 armored door cord	
	1 electrified lock	Best 45HW7DEU x 15J x 626
	1 card reader	Specified by Electrical
	1 power supply	Specified by Electrical

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PART 3 EXECUTION (Not Applicable)

-- End of Section Table of Contents --

SECTION 09 06 90

COLOR SCHEDULE

PART 1 GENERAL

1.1 SUMMARY

This section covers color of exterior and interior materials and products.

1.2 SYSTEM DESCRIPTION

This section covers only the color of the exterior and interior materials and products that are exposed to view in the finished construction. The word "color", as used herein, includes surface color and pattern. Requirements for quality and method of installation are covered in other appropriate sections of the specifications. Specific locations where the various materials are required are shown on the drawings. Items not designated for color in this section may be specified in other sections. When color is not designated for items, propose a color for approval.

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Color Schedule

PART 2 PRODUCTS

2.1 REFERENCE TO MANUFACTURER'S COLOR

Where color is shown as being specific to one manufacturer, an equivalent color by another manufacturer may be submitted for approval. Manufacturers and materials specified are not intended to limit the selection of equal colors from other manufacturers.

2.2 COLOR SCHEDULE

The color schedule lists the colors, patterns and textures required for exterior and interior finishes, including both factory applied and field applied colors. Submit 3 sets of color boards, 90 days after the Contractor is given Notice to proceed, complying with the following requirements:

a. Color boards shall reflect all actual finish textures, patterns, and colors required for this contract.

b. Materials shall be labeled with the finish type, manufacturer's name, pattern, and color reference.

c. Samples shall be on size 8-1/2 by 11 inch boards with a maximum spread of size 25-1/2 by 33 inches for foldouts.

d. Samples for this color board are required in addition to samples requested in other specification sections.

2.2.1 Exterior Walls and Canopy Structure

2.2.1.1 Canopy Structural Steel:

Sherwin Williams 7064 Passive

2.2.1.2 Metal Wall Panels and Associated Trim:

Sherwin Williams 6800 Something Blue

2.2.2 Exterior Trim

Exterior trim shall be as noted on the drawings.

2.2.2.1 Steel Doors and Door Frames:

Sherwin Williams 6800 Something Blue

2.2.2.2 Downspouts, Gutters, and Flashings:

Sherwin Williams 7070 Site White

2.2.2.3 Caulking and Sealants:

Refer to Section 07 92 00 JOINT SEALANTS

2.2.3 Exterior Roof

Roof color shall apply to exterior roof surfaces including sheet metal flashings and roof trim, and similar items. Provide roof color to match the colors listed below.

2.2.3.1 Metal:

Sherwin Williams 7070 Site White

2.2.4 Interior Floor Finishes

Provide flooring materials to match the colors listed below.

2.2.4.1 Vinyl Composition Tile:

Armstrong Standard Excelon, 51933 Blue Cloud

2.2.4.2 Sheet Vinyl:

Armstrong Medintone, H8300 Cool White

2.2.4.3 Porcelain Tile:

Daltile, Artic White Speckle B926

2.2.4.4 Grout:

Custom Building Products, #381 Bright White

2.2.5 Interior Base Finishes

Provide base materials to match the colors listed below.

2.2.5.1 Resilient Base and Moldings:

Black

2.2.5.2 Coved Porcelain Tile:

Match porcelain floor tile.

2.2.5.3 Grout:

Match floor grout.

2.2.5.4 Coved Sheet Vinyl:

Match floor sheet vinyl.

2.2.6 Interior Wall Finishes

Interior wall color shall apply to the entire wall surface, including reveals, vertical furred spaces, grilles, diffusers, electrical and access panels, and piping and conduit adjacent to wall surfaces unless otherwise specified. Items not specified in other paragraphs shall be painted to match adjacent wall surface. Provide wall materials to match the colors listed below.

2.2.6.1 Paint:

Sherwin Williams 7006 Extra White

2.2.6.2 Ceramic Tile:

Daltile, Pepper White, 0147

2.2.6.3 Ceramic Tile Grout:

Custom Building Products, #381 Bright White

2.2.7 Interior Ceiling Finishes

Ceiling colors shall apply to ceiling surfaces including soffits, furred down areas, grilles, diffusers, registers, and access panels. Ceiling color shall also apply to joist, underside of roof deck, and conduit and piping where joists and deck are exposed and required to be painted. Provide ceiling materials to match the colors listed below.

2.2.7.1 Acoustical Tile and Grid:

White

2.2.7.2 Paint:

Match wall.

2.2.8 Interior Trim

Provide interior trim to match the colors listed below.

2.2.8.1 Doors:

Match existing.

2.2.8.2 Door Frames:

Match existing.

2.2.9 Interior Miscellaneous

Provide miscellaneous items to match the colors listed below.

2.2.9.1 Wall Switch Handles and Standard Receptacle Bodies:

White

2.2.9.2 Electrical Device Cover Plates:

White

PART 3 EXECUTION (Not Applicable)

-- End of Section --

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SECTION 09 22 00

SUPPORTS FOR GYPSUM BOARD

PART 1 GENERAL

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1.4 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

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2.1.1 Materials for Attachment of Gypsum Wallboard
2.1.1.1 Suspended and Furred Ceiling Systems
2.1.1.2 Nonload-Bearing Wall Framing and Furring

PART 3 EXECUTION

3.1 INSTALLATION
3.1.1 Systems for Attachment of Gypsum Wallboard
3.1.1.1 Suspended and Furred Ceiling Systems
3.1.1.2 Non-loadbearing Wall Framing and Furring
3.2 ERECTION TOLERANCES

-- End of Section Table of Contents --

SECTION 09 22 00

SUPPORTS FOR GYPSUM BOARD

PART 1 GENERAL

1.1 SUMMARY

This section covers non-loadbearing cold-formed metal framing, furring, and ceiling suspension systems for the attachment of lath, plaster, stucco, and wallboard.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM A463/A463M	Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 645	Nonstructural Steel Framing Members
ASTM C 754	Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Metal support systems

Submit for the erection of metal ceiling suspension systems. Indicate materials, sizes, thicknesses, and fastenings.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations.

Storage area shall permit easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

PART 2 PRODUCTS

2.1 MATERIALS

Provide steel materials for metal support systems with galvanized coating ASTM A653/A653M, G-60; aluminum coating ASTM A463/A463M, T1-25; or a 55-percent aluminum-zinc coating. Provide support systems and attachments per UFC 3-310-04, "Seismic Design for Buildings" in seismic zones.

2.1.1 Materials for Attachment of Gypsum Wallboard

2.1.1.1 Suspended and Furred Ceiling Systems

ASTM C 645.

2.1.1.2 Nonload-Bearing Wall Framing and Furring

ASTM C 645, but not thinner than 0.0179 inch thickness, with 0.0329 inch minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Systems for Attachment of Gypsum Wallboard

3.1.1.1 Suspended and Furred Ceiling Systems

ASTM C 754, except provide framing members 16 inches o.c. unless indicated otherwise.

3.1.1.2 Non-loadbearing Wall Framing and Furring

ASTM C 754, except as indicated otherwise.

3.2 ERECTION TOLERANCES

Provide framing members which will be covered by finish materials such as wallboard, plaster, or ceramic tile set in a mortar setting bed, within the following limits:

a. Layout of walls and partitions: 1/4 inch from intended position;

b. Plates and runners: 1/4 inch in 8 feet from a straight line;

c. Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and

d. Face of framing members: 1/4 inch in 8 feet from a true plane.

Provide framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive within the following limits:

a. Layout of walls and partitions: 1/4 inch from intended position;

b. Plates and runners: 1/8 inch in 8 feet from a straight line;

c. Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

d. Face of framing members: 1/8 inch in 8 feet from a true plane.

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2.1.2.1 Regular
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2.1.4 Joint Treatment Materials
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3.2.2 Application of Gypsum Board to Steel Framing and Furring
3.3 APPLICATION OF CEMENTITIOUS BACKER UNITS
3.3.1 Application
3.3.2 Joint Treatment
3.4 FINISHING OF GYPSUM BOARD
3.5 SEALING

3.6 PATCHING

-- End of Section Table of Contents --

SECTION 09 29 00

GYPSUM BOARD

PART 1 GENERAL

1.1 SUMMARY

This section covers gypsum board, cementitious backer units, and accessories intended for use in drywall construction.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11	Specifications for Interior Installation of Cementitious Backer Units

ASTM INTERNATIONAL (ASTM)

ASTM C 1002	Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
ASTM C 1047	Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C 1396/C 1396M	Standard Specification for Gypsum Board
ASTM C 475/C 475M	Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 840	Application and Finishing of Gypsum Board
ASTM C 954	Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness

GYPSUM ASSOCIATION (GA)

GA 214	Recommended Levels of Gypsum Board Finish
GA 216	Application and Finishing of Gypsum Panel

Products

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Gypsum Board

Cementitious backer units

Water-Resistant Gypsum Backing Board

Joint Treatment Materials

Accessories

Submit for each type of gypsum board and for cementitious backer units.

SD-07 Certificates

Asbestos Free Materials

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

SD-08 Manufacturer's Instructions

Material Safety Data Sheets

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.4.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation. Store per manufacturer's recommendations for allowable temperature and humidity range. Do not store panels near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.4.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.5 ENVIRONMENTAL CONDITIONS

1.5.1 Temperature

Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

1.5.2 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

1.5.3 Temporary Ventilation

Provide temporary ventilation for work of this section.

1.6 QUALIFICATIONS

Furnish type of gypsum board work specialized by the installer with a minimum of 3 years of documented successful experience.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only.

Submit Material Safety Data Sheets for gypsum materials including adhesives.

2.1.1 Gypsum Board

ASTM C 1396/C 1396M. Paper facings shall contain 100 percent post-consumer recycled paper content. Gypsum cores shall contain a minimum of 95 percent post-industrial recycled gypsum content.

2.1.1.1 Regular

48 inch wide, 1/2 inch thick, tapered edges.

2.1.2 Regular Water-Resistant Gypsum Backing Board

ASTM C 1396/C 1396M

2.1.2.1 Regular

48 inch wide, 1/2 inch thick, tapered edges at walls.

48 inch wide, 5/8 inch thick, tapered edges at ceilings.

2.1.3 Cementitious Backer Units

48 inch wide, 1/2 inch thick.

2.1.4 Joint Treatment Materials

ASTM C 475/C 475M. Use all purpose joint and texturing compound containing inert fillers and natural binders, including lime compound. Pre-mixed compounds shall be free of antifreeze, vinyl adhesives, preservatives, biocides and other slow releasing compounds.

2.1.4.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.4.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.4.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.4.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.4.5 Joint Tape

Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.5 Fasteners

2.1.5.1 Screws

ASTM C 1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.033 inch thick. ASTM C 954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick. Provide cementitious backer unit screws with a polymer coating.

2.1.6 Accessories

ASTM C 1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

2.1.7 Water

Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and

spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C 840 or GA 216 and the requirements specified. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length; select panel sizes to minimize waste. Cut out gypsum board to make neat, close, and tight joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Lay out panels to minimize waste; reuse cutoffs whenever feasible. Surfaces of gypsum board and substrate members may not be bonded together with an adhesive. Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 Application of Single-Ply Gypsum Board to Wood Framing

Apply in accordance with ASTM C 840, System I or GA 216.

3.2.2 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C 840, System VIII or GA 216.

3.3 APPLICATION OF CEMENTITIOUS BACKER UNITS

3.3.1 Application

In wet areas (tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply cementitious backer units in accordance with ANSI A108.11.

3.3.2 Joint Treatment

ANSI A108.11.

3.4 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C 840, GA 214 and GA 216.

Level 2: water resistant gypsum backing board, ASTM C 1396/C 1396M, to receive ceramic tile in accordance with GA 214.

Level 5: unless otherwise specified, finish all gypsum board walls, partitions and ceilings in accordance with GA 214.

Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer. Protect

workers, building occupants, and HVAC systems from gypsum dust.

3.5 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07 92 00 JOINT SEALANTS Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.6 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

-- End of Section --

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SECTION 09 30 00

CERAMIC TILE AND PORCELAIN TILE

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2.2.2 Portland Cement
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2.2.4 Hydrated Lime
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2.4 MORTAR, GROUT, AND ADHESIVE
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SECTION 09 30 00

CERAMIC TILE AND PORCELAIN TILE

PART 1 GENERAL

1.1 SUMMARY

This section covers ceramic tile for walls and floors, porcelain tile, quarry tile, paver tile, and marble thresholds.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A 108.11	Specifications for Interior Installation of Cementitious Backer Units
ANSI A 118.10	Load Bearing, Bonded, Waterproof Membranes for Thin-set Ceramic Tile and Dimension Stone Installation

ASTM INTERNATIONAL (ASTM)

ASTM A185/A185M	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM C 1026	Standard Test Method for Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1027	Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C 1028	Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
ASTM C 144	Standard Specification for Aggregate for Masonry Mortar
ASTM C 150/C 150M	Standard Specification for Portland Cement
ASTM C 206	Standard Specification for Finishing

	Hydrated Lime
ASTM C 207	Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C 241/C 241M	Standard Specification for Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C 33/C 33M	Standard Specification for Concrete Aggregates
ASTM C 373	Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
ASTM C 482	Bond Strength of Ceramic Tile to Portland Cement
ASTM C 501	Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
ASTM C 648	Breaking Strength of Ceramic Tile

BAY AREA AIR QUALITY MANAGEMENT DISTRICT (Bay Area AQMD)

Bay Area AQMD Rule 8-51	Adhesive and Sealant Products

MARBLE INSTITUTE OF AMERICA (MIA)

MIA Design Manual	Dimension Stone Design Manual

TILE COUNCIL OF NORTH AMERICA (TCNA)

TCA Hdbk	Handbook for Ceramic Tile Installation

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

For materials like Tile, Accessories, and marble Thresholds submit Samples of sufficient size to show color range, pattern, type and joints.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Tile
Setting-Bed
Mortar, Grout, and Adhesive

Waterproofing and Crack Suppression Membrane

SD-04 Samples

Tile
Marble Thresholds
Grout

SD-07 Certificates

Tile
Mortar, Grout, and Adhesive

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Protect materials from weather, and store them under cover in accordance with manufacturer's printed instructions.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not perform ceramic tile work unless the substrate and ambient temperature is at least 50 degrees F and rising. Maintain temperature above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used, ventilate the area to the outside to avoid carbon dioxide damage to new tilework.

1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period.

1.8 EXTRA MATERIALS

Supply an extra two percent of each type tile used in clean and marked cartons.

PART 2 PRODUCTS

2.1 TILE

Conform to TCA Hdbk for standard grade tile. Provide grade sealed containers. Mark seals with the marks on the signed master grade certificate. Provide an impact resistant tile with a minimum floor breaking strength for wall tile of 90 pound and for floor tile of 250 pound in accordance with ASTM C 648. The manufacturer will provide a frost resistant rating for tile used in cold climate projects as determined by ASTM C 1026. Provide a 0.50 maximum percent water absorption in accordance with ASTM C 373. Provide a minimum coefficient of friction of 0.60 wet and dry in accordance with ASTM C 1028. Identify floor tile as Class III-Medium Heavy Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C 1027 for abrasion resistance as related to foot traffic. Coordinate the color with Section 09 06 90 COLOR SCHEDULE. Submit manufacturer's catalog data and preprinted installation and cleaning instructions plus a master grade certificate for tile.

2.1.1 Porcelain Tile

Furnish an unglazed porcelain tile and integral cove trim with the color extending uniformly through the body of the tile. Provide a nominal size of 12 by 12 by 5/16 inch thick for the field tile. Criteria for tile to meet or exceed is as follows: Abrasive wear in accordance with ASTM C 501 and bonding strength in accordance with ASTM C 482. Comply with 36 CFR 1191 for coefficient of friction for interior tiled floors. Coordinate color with Section 09 06 90 COLOR SCHEDULE.

2.1.2 Glazed Wall Tile

Provide glazed wall tile with cushioned edges and trim edged with lead-free bright finish. Provide tile 4-1/4 by 4-1/4 inch. Coordinate color with Section 09 06 90 COLOR SCHEDULE.

2.2 SETTING-BED

Compose the setting-bed of the following materials:

2.2.1 Aggregate for Concrete Fill

Conform to ASTM C 33/C 33M for aggregate fill. Do not exceed one-half the thickness of concrete fill for maximum size of coarse aggregate.

2.2.2 Portland Cement

Conform to ASTM C 150/C 150M for cement, Type I, white for wall mortar and gray for other uses.

2.2.3 Sand

Conform to ASTM C 144 for sand.

2.2.4 Hydrated Lime

Conform to ASTM C 206 for hydrated lime, Type S or ASTM C 207, Type S.

2.2.5 Reinforcing Wire Fabric

Conform to ASTM A185/A185M for wire fabric. Provide 2 by 2 inch mesh, 16/16 wire.

2.3 WATER

Provide potable water.

2.4 MORTAR, GROUT, AND ADHESIVE

Submit certificates indicating conformance with specified requirements. Conform to Bay Area AQMD Rule 8-51, and to the following for mortar, grout, adhesive, and sealant:

2.4.1 Latex-Portland Cement Mortar

TCA Hdbk and meets to following:

a. Compressive Strength, ANSI A 118.10: >2500 psi

b. Seam Strength, ANSI A 118.10:90 lb/in width

2.4.2 Ceramic Tile Grout

TCA Hdbk; petroleum-free and plastic-free latex-portland cement grout.

2.4.3 Sealants

Comply with applicable regulations regarding toxic and hazardous materials and as specified under Section 07 92 00 JOINT SEALANTS.

2.5 MARBLE THRESHOLDS

Provide marble thresholds of size required by drawings or conditions. Categorize marble Group A as classified by MIA Design Manual. Provide a fine sand-rubbed finish marble with white in color as approved by the COR. Provide minimum 12.0 marble abrasion when tested in accordance with ASTM C 241/C 241M.

2.6 WATERPROOFING AND CRACK SUPPRESSION MEMBRANE

Provide a bonding thin, cold applied single component liquid and reinforcing fabric that provides a flexible, seamless waterproofing membrane designed for heavy-duty applications and that complies with ANSI A 118.10. Materials to be non-toxic, non-flammable and non-hazardous during storage, mixing and application when cured.

a. Custom Building Products 9240 or approved equal.

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of TCA Hdbk for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:

TYPE	WALLS	FLOORS
Latex Portland Cement Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.

3.2 GENERAL INSTALLATION REQUIREMENTS

Do not start tile work until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Do not start floor tile installation in spaces requiring wall tile until after wall tile has been installed. Apply tile in colors and patterns indicated in the area shown on the drawings. Install tile with the respective surfaces in true even planes to the elevations and grades shown. Provide special shapes as required for sills, jambs, recesses, offsets, external corners, and other

conditions to provide a complete and neatly finished installation. Solidly back tile bases and coves with mortar.

3.3 INSTALLATION OF WALL TILE

Install wall tile at shower area in accordance with the TCA Hdbk, method B415.

3.3.1 Latex-Portland Cement Mortar

Use Latex-Portland Cement to install tile in accordance with TCA Hdbk.

3.4 INSTALLATION OF FLOOR TILE

Install floor tile, and waterproof and crack-suppression membrane over concrete floor in accordance with TCA Hdbk method F122.

At shower area, install floor tile, and waterproof and crack-suppression membrane over concrete floor in accordance with TCA Hdbk method B415.

Install waterproofing and crack-suppression membrane to comply with ANSI A 108.11 and waterproofing manufacturer's written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate. Do not install tile over membrane until membrane has cured and been tested to determine that it is watertight.

3.4.1 Workable or Cured Mortar Bed

Install floor tile at shower area over a workable mortar bed or a cured mortar bed at the option of the Contractor. Conform to TCA Hdbk for workable mortar bed materials and installation. Provide minimum 1/4 inch to maximum 3/8 inch joints in uniform width.

3.4.2 Latex-Portland Cement

Use Latex-Portland cement mortar to install tile directly over properly cured, plane, clean concrete slabs in accordance with TCA Hdbk. Use Latex Portland cement when installing porcelain ceramic tile.

3.4.3 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCA Hdbk.

3.5 INSTALLATION OF MARBLE THRESHOLDS

Install thresholds where indicated, in a manner similar to that of the ceramic tile floor. Provide thresholds full width of the opening. Install head joints at ends not exceeding 1/4 inch in width and grouted full.

3.6 CLEANING AND PROTECTING

Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions. Do not use acid for cleaning glazed tile. Clean floor tile with resinous grout or with factory mixed grout in accordance with printed instructions of the grout manufacturer. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall surfaces. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors. Provide board walkways on

tiled floors that are to be continuously used as passageways by workmen. Replace damaged or defective tiles.

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SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

This section covers conventional and impact/abrasion resistant acoustical ceiling tile and panels, unit acoustical absorbers, hangers, and suspension system grid for installation in commercial-type work.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM A641/A641M	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM C 423	Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C 635/C 635M	Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636/C 636M	Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM C 834	Latex Sealants
ASTM E 1264	Acoustical Ceiling Products
ASTM E 1477	Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers
ASTM E 795	Mounting Test Specimens During Sound Absorption Tests

1.3 SYSTEM DESCRIPTION

Provide a ceiling suspension system for acoustical tile. The location and

extent of acoustical treatment shall be as shown on the drawings.

1.3.1 Ceiling Sound Absorption

Determine the Noise Reduction Coefficient (NRC) in accordance with ASTM C 423 Test Method.

1.3.2 Light Reflectance

Determine light reflectance factor in accordance with ASTM E 1477 Test Method.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Acoustical Ceiling Systems

SD-04 Samples

Acoustical Units

1.5 DELIVERY, STORAGE AND HANDLING

Deliver materials to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store materials in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.6 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

1.7 SCHEDULING

Complete and dry interior finish work before ceiling installation. Complete mechanical, electrical, and other work above the ceiling line; install and start operating heating, ventilating, and air conditioning systems in order to maintain temperature and humidity requirements.

1.8 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period. Include an agreement to repair or replace acoustical panels that fail within the warranty period in the standard performance guarantee or warranty. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

PART 2 PRODUCTS

2.1 ACOUSTICAL CEILING SYSTEMS

Submit two samples of each type of acoustical units and each type of suspension grid tee section showing texture, finish, and color. Conform acoustical units to ASTM E 1264, Class A, and the following requirements:

Submit detail drawings indicating layout and installation of acoustical units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system and other ceiling surface mounted devices.

2.1.1 Units for Exposed-Grid System

a. Type: III (non-asbestos mineral fiber with painted finish).

b. Flame Spread: Class A, 25 or less

c. Minimum NRC: 0.60 when tested on mounting Type E-400 of ASTM E 795.

d. Minimum Light Reflectance Coefficient: LR-1, 0.75 or greater.

e. Nominal size: 24 by 48 inch.

f. Edge detail: Square.

g. Finish: Factory-applied standard finish.

h. Minimum CAC: 35.

i. Basis of Design: Armstrong Cirrus Tile

2.2 SUSPENSION SYSTEM

Provide standard suspension system conforming to ASTM C 635/C 635M for intermediate-duty systems. Provide surfaces exposed to view of aluminum or steel with a factory-applied white baked-enamel finish. Provide wall molding having a flange of not less than 2 inch. Provide standard corners. Suspended ceiling framing system must have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. Provide a suspension system with a maximum deflection of 1/360 of the span length. Conform seismic details to the contract drawings.

2.3 HANGERS

Provide hangers and attachment capable of supporting a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

2.3.1 Wires

Conform wires to ASTM A641/A641M, Class 1, 0.0808 inch in diameter.

2.4 FINISHES

Use manufacturer's standard textures, patterns and finishes as specified for acoustical units and suspension system members. Treat ceiling suspension system components to inhibit corrosion.

2.5 ACOUSTICAL SEALANT

Conform acoustical sealant to ASTM C 834, nonstaining.

PART 3 EXECUTION

3.1 INSTALLATION

Complete and approve mechanical, electrical, and other work above the ceiling line prior to the start of acoustical ceiling installation. Provide acoustical work complete with necessary fastenings, clips, and other accessories required for a complete installation. Do not expose mechanical fastenings in the finished work. Lay out hangers for each individual room or space. Provide hangers to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span. Wherever required to bypass an object with the hanger wires, install a subsuspension system so that all hanger wires will be plumb.

3.1.1 Suspension System

Install suspension system in accordance with ASTM C 636/C 636M and as specified herein.

3.1.1.1 Plumb Hangers

Install hangers plumb and not pressing against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, provide hangers at a minimum of four hangers per fixture and located not more than 6 inch from each corner of each fixture.

3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, offset the resulting horizontal force by bracing, countersplaying, or other acceptable means.

3.1.2 Wall Molding

Provide wall molding where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Secure wall molding not more than 3 inch from ends of each length and not more than 16 inch on centers between end fastenings. Provide wall molding springs at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Install acoustical units in accordance with the approved installation instructions of the manufacturer. Ensure that edges of acoustical units are in close contact with metal supports, with each other, and in true alignment.

3.1.4 Caulking

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings.

3.2 CLEANING

Following installation, clean dirty or discolored surfaces of acoustical units and leave them free from defects. Remove units that are damaged or improperly installed and provide new units as directed.

3.3 RECLAMATION PROCEDURES

Neatly stack ceiling tile, designated for recycling by the COR, on 4 by 4 foot pallets not higher than 4 foot. Panels must be completely dry. Shrink wrap and symmetrically stack pallets on top of each other without falling over.

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SECTION 09 65 00

RESILIENT FLOORING

PART 1 GENERAL

1.1 SUMMARY

This section covers resilient floor coverings, base materials, and accessory items.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM D 4078	Water Emulsion Floor Polish
ASTM E 648	Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F 1066	Standard Specification for Vinyl Composition Floor Tile
ASTM F 1303	Sheet Vinyl Floor Covering with Backing
ASTM F 1482	Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
ASTM F 1861	Resilient Wall Base
ASTM F1869	Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F 2170	Determining Relative Humidity in Concrete Floor Slabs in situ Probes
ASTM F 710	Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

1.3 SYSTEM DESCRIPTION

1.3.1 Fire Resistance Requirements

Provide a minimum average critical radiant flux of 0.45 watts per square centimeter for flooring in corridors and exits when tested in accordance with ASTM E 648.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Resilient Flooring and Accessories
Adhesives
Vinyl Composition Tile
Sheet Vinyl Flooring
Wall Base

SD-04 Samples

Resilient Flooring and Accessories

SD-06 Test Reports

Moisture, Alkalinity and Bond Tests

SD-08 Manufacturer's Instructions

Surface Preparation
Installation

SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Store materials in a clean, dry, secure, and well-ventilated area free from strong contaminant sources and residues with ambient air temperature maintained above 68 degrees F and below 85 degrees F, stacked according to manufacturer's recommendations. Remove resilient flooring products from packaging to allow ventilation prior to installation. Protect materials from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Observe ventilation and safety procedures specified in the MSDS. Do not store rubber surface products with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.6 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 68 degrees F and below 85 degrees F for 3 days before application, during

application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 55 degrees F thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.7 SCHEDULING

Schedule resilient flooring application after the completion of other work which would damage the finished surface of the flooring.

1.8 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

PART 2 PRODUCTS

2.1 VINYL COMPOSITION TILE

Conform to ASTM F 1066 Class 1, (solid color tile), Composition 1, asbestos-free, 12 inch square and 1/8 inch thick. Provide color and pattern uniformly distributed throughout the thickness of the tile.

2.2 SHEET VINYL FLOORING

Conform to ASTM F 1303, Type I, Grade 1, Class B-nonfoamed plastic backing (minimum wear layer thickness 0.020 inch and minimum overall thickness 0.080 inch) and a minimum 6 feet wide. As required, provide welding rods as recommended by the manufacturer for heat welding of joints.

2.3 WALL BASE

Conform to ASTM F 1861, Type TS (vulcanized thermoset rubber), Style B (coved - installed with resilient flooring). Provide 4 inch high and a minimum 1/8 inch thick wall base. Provide job formed corners in matching height, shape, and color.

2.4 INTEGRAL COVE BASE

Extend integral coved base for sheet vinyl flooring up the wall 4 inch. Provide a clear anodized aluminum, square cap strip and vinyl, rubber, or wood fillet strip with a minimum radius of 3/4 inch for integral coved bases at perimeter and fixed vertical interruptions to flooring. Provide integral cove of the same material as flooring.

2.5 MOULDING

Provide tapered mouldings of vinyl and types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified. Provide vertical lip on moulding of maximum 1/4 inch. Provide bevel change in level between 1/4 and 1/2 inch with a slope no greater than 1:2.

2.6 ADHESIVES

Provide adhesives for flooring, base and accessories as recommended by the manufacturer and comply with local indoor air quality standards. VOC content shall be less than 50 grams/L. Submit manufacturer's descriptive

data, documentation stating physical characteristics, and mildew and germicidal characteristics. Provide Material Safety Data Sheets (MSDS) for all primers and adhesives to the COR. Highlight VOC emissions.

2.7 SURFACE PREPARATION MATERIALS

Provide surface preparation materials, such as panel type underlayment, lining felt, and floor crack fillers as recommended by the flooring manufacturer for the concrete subfloor conditions.

2.8 POLISH/FINISH

Provide polish finish as recommended by the manufacturer and conform to ASTM D 4078 for polish.

2.9 CAULKING AND SEALANTS

Provide caulking and sealants in accordance with Section 07 92 00 JOINT SEALANTS.

2.10 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture for resilient flooring and accessories selected from manufacturer's standard colors. Provide flooring in any one continuous area or replacement of damaged flooring in continuous area from same production run with same shade and pattern. Submit manufacturer's descriptive data and three samples of each indicated color and type of flooring, base, mouldings, and accessories sized a minimum 2-1/2 by 4 inch. Submit Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 3 EXECUTION

3.1 EXAMINATION

Examine and verify that site conditions are in agreement with the design package. Report all conditions that will prevent a proper installation. Do not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer. Submit manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, seaming techniques, and recommended adhesives.

3.2 SURFACE PREPARATION

Provide a smooth, true, level plane for surface preparation of the flooring, except where indicated as sloped. Floor to be flat to within 3/16 inch in 10 feet. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Prepare the surfaces of lightweight concrete slabs (as defined by the flooring manufacturer) as recommended by the flooring manufacturer. Comply with ASTM F 710 for concrete subfloor preparation. Floor fills or toppings may be required as recommended by the flooring manufacturer. Install underlayments, when required by the flooring manufacturer, in accordance with manufacturer's recommended printed installation instructions. Comply with ASTM F 1482 for panel type underlayments. Before any work under this section is begun, correct all defects such as rough or scaling concrete, chalk and dust, cracks, low spots, high spots, and uneven surfaces. Repair all damaged portions of concrete slabs as recommended by the flooring manufacturer.

Remove concrete curing and sealer compounds from the slabs, other than the type that does not adversely affect adhesion. Remove paint, varnish, oils, release agents, sealers, waxes, and adhesives, as required by the flooring product in accordance with manufacturer's printed installation instructions.

3.3 MOISTURE, ALKALINITY AND BOND TESTS

Determine the suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F 1869 or ASTM F 2170, unless otherwise recommended by the flooring manufacturer. Conduct alkalinity testing as recommended by the flooring manufacturer. Determine the compatibility of the resilient flooring adhesives to the concrete floors by a bond test in accordance with the flooring manufacturer's recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test stating date of test, person conducting the test, and the area tested.

3.4 PLACING VINYL COMPOSITION TILES

Install tile flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's directions. Keep tile lines and joints square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Vary edge width as necessary to maintain full-size tiles in the field, no edge tile to be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe edge tile to walls and partitions after field flooring has been applied.

3.5 PLACING SHEET VINYL FLOORING

Install sheet vinyl flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Lay out sheets to minimize waste. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied. Provide heat welded seams and edges in accordance with the manufacturer's written installation instructions. Finish joints flush, free from voids, recesses, and raised areas. Install flooring with an integral coved base.

3.6 PLACING MOULDING

Provide moulding where flooring termination is higher than the adjacent finished flooring and at transitions between different flooring materials. When required, locate moulding under door centerline. Moulding is not required at doorways where thresholds are provided. Secure moulding with adhesive as recommended by the manufacturer. Prepare and apply adhesives in accordance with manufacturer's printed directions.

3.7 PLACING WALL BASE

Install wall base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with

manufacturer's printed directions. Tighten base joints and make even with adjacent resilient flooring. Fill voids along the top edge of base at masonry walls with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

3.8 PLACING INTEGRAL COVED BASE

Install integral cove base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Shape integral coved base by extending the flooring material onto the wall surface. Support cove by a filler. Provide a cap strip at the top of the base. Fill voids along the top edge of base at masonry walls with caulk.

3.9 CLEANING

Immediately upon completion of installation of flooring in a room or an area, dry/clean the flooring and adjacent surfaces to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions. No sooner than 5 days after installation, wash flooring with a nonalkaline cleaning solution, rinse thoroughly with clear cold water, and, except for rubber flooring and stair treads, risers and stringers, vinyl and other flooring not requiring polish finish by manufacturer, apply the number of coats of polish in accordance with manufacturer's written instructions. Clean and maintain all other flooring as recommended by the manufacturer.

3.10 WASTE MANAGEMENT

Separate offcuts and waste materials and reuse or recycle in accordance with the Waste Management Plan, keeping sheet materials larger than 2 square feet and tiles larger than 1/2 tiles separate for reuse. Identify manufacturer's policy for collection or return of construction scrap, unused material, demolition scrap, and/or packaging material. Place materials defined as hazardous or toxic waste in designated containers and dispose of properly. Close and seal tightly partly used sealant and adhesive containers and store protected in a well ventilated fire-safe area at moderate temperature.

3.11 PROTECTION

From the time of installation until acceptance, protect flooring from damage as recommended by the flooring manufacturer. Remove and replace flooring which becomes damaged, loose, broken, or curled and wall base which is not tight to wall or securely adhered.

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SECTION 09 77 00

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SECTION 09 77 00

FRP WALL LINER PANELS

PART 1 GENERAL

1.1 SUMMARY

This section covers FRP wall liner panels.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM D 256	Determining the Izod Pendulum Impact Resistance of Plastics
ASTM D 570	Standard Test Method for Water Absorption of Plastics
ASTM D 790	Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D 2583	Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

SD-03 Product Data

Fiberglass reinforced plastic (FRP) panels

Installation

SD-04 Samples

FRP panels

FRP color samples

Accessories

1.4 SYSTEM DESCRIPTION

Provide fiberglass reinforced plastic (FRP) laminated panels which have been manufactured and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Package sheets on skids or pallets for shipment to project site. Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer. Store panels indoors in a dry place at the project site. Remove foreign matter from face of panel by using a soft bristle brush, avoiding abrasive action.

1.6 WARRANTY

Submit Manufacturer's Warranty executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents. Warranty Period: 10 years commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 FIBERGLASS REINFORCED PLASTIC (FRP) PANELS

Submit sample FRP Panels showing specified finish and FRP color samples.

2.1.1 FRP Panels

a. Nominal Dimensions: 4 feet by 8 feet.

b. Nominal Laminated Panel Thickness: 0.375 inches minimum with nominal sheet thickness of 0.090 inch.

c. Finish Face of Panel: Smooth.

d. Color: Submit manufacturer's standard colors.

Flexural Strength ASTM D 790: 17,000 ps

Water Absorption ASTM D 570, 21 degrees C at 72 hrs: 0.17 %

Izod Impact Strength ASTM D 256: 7.0 foot-pounds/inch

Barcol Hardness, ASTM D 2583: minimum of 30

Surface Burning Characteristics, ASTM E 84: Flame Spread Index of 200 and Smoke Developed Index less than 450.

f. Basis of Design: Glasteel Glasliner FRP, or approved equal.

2.2 ACCESSORIES

Provide PVC moldings of same manufacturer and color as liner panels for panel dividers, inside and outside corners and end caps.

Fasteners of nylon rivets, one-piece, non-corroding and of same manufacturer and color as liner panels.

Water based adhesive as recommended by panel manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

Examine areas to receive liner panels. Notify COR of conditions that would adversely affect installation of panels. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

Ensure solid wall surfaces to receive liner panels are plumb, clean, flat, smooth and dry. Precondition liner panels before installation in accordance with manufacturer's instruction

3.3 INSTALLATION

Install liner panels plumb, level, square and in proper alignment in accordance with manufacturer's instructions, laying out panels to minimize joints and cutting panels in accordance with manufacturer's instructions.

Apply adhesive in accordance with manufacturer's instructions along with fasteners when installing liner panels.

Install liner panels with gap at ceiling, wall base/floor, and between panels in accordance with manufacturer's instructions to allow for expansion and contraction of panels due to changes in temperature. Allow for expansion and contraction of liner panels when pre-drilling holes for fasteners and when installing around penetrations, including pipes, conduits and electrical outlets.

Install moldings and silicone sealant with liner panels in accordance with manufacturer's instructions to achieve moisture-resistant installation.

3.4 CLEAN-UP

Remove excess silicone sealant during installation, or trim after silicone has cured. Clean panels after installation in accordance with manufacturer's instructions. Do not use harsh or abrasive cleaning materials or methods that would damage liner panels or finish.

3.5 PROTECTION

Protect installed liner panels and finish from damage during construction.

-- End of Section --

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DIVISION 09 - FINISHES

SECTION 09 90 00

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SECTION 09 90 00

PAINTS AND COATINGS

PART 1 GENERAL

1.1 SUMMARY

This section covers painting of new and existing, interior and exterior substrates, including masonry, concrete, metal, wood and other miscellaneous materials.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100Doc	Documentation of the Threshold Limit Values and Biological Exposure Indices

ASTM INTERNATIONAL (ASTM)

ASTM D 4263	Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4444	Use and Calibration of Hand-Held Moisture Meters
ASTM D 523	Standard Test Method for Specular Gloss
ASTM D 6386	Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM F1869	Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI 101	Epoxy Anti-Corrosive Metal Primer
MPI 107	Rust Inhibitive Primer (Water-Based)
MPI 11	Exterior Latex, Semi-Gloss, MPI Gloss Level 5

MPI 134	Galvanized Primer (Waterbased)
MPI 145	Institutional Low Odor / VOC Interior Latex, MPI Gloss Level 3
MPI 147	Institutional Low Odor / VOC Interior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 153	Interior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 163	Exterior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 39	Interior Latex-Based Wood Primer
MPI 50	Interior Latex Primer Sealer
MPI 72	Polyurethane, Two Component, Pigmented, Gloss

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	Shop, Field, and Maintenance Painting of Steel
SSPC PA Guide 3	A Guide to Safety in Paint Application
SSPC SP 1	Solvent Cleaning
SSPC SP 2	Hand Tool Cleaning
SSPC SP 3	Power Tool Cleaning
SSPC SP 6/NACE No.3	Commercial Blast Cleaning
SSPC VIS 3	Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	Safety and Health Requirements Manual

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313	Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

SD-02 Shop Drawings

Piping identification

SD-03 Product Data

Coating

Manufacturer's Technical Data Sheets

SD-04 Samples

Color

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

SD-07 Certificates

Applicator's qualifications

Qualification Testing laboratory for coatings

SD-08 Manufacturer's Instructions

Application instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets, Code JQ

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings:

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

SD-11 Closeout Submittals

Material Safety Data Sheet

Paint MSDS submitted to Code JQ for compliance documentation.

1.4 APPLICATOR'S QUALIFICATIONS

1.4.1 Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three similar projects within the past five years. List information by individual and include the following:

a. Name of individual and proposed position for this work.

b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address, telephone number, and telex number (if non-US) of facility owner

Name of individual in facility owner's organization who can be contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

1.5 QUALITY ASSURANCE

1.5.1 Field Samples and Tests

The COR may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that conform to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

1.5.1.1 Sampling Procedure

The COR will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one quart samples of the selected paint materials. The samples shall be taken in the presence of the COR, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.5.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.6 REGULATORY REQUIREMENTS

1.6.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District (BAAQMD) and regional jurisdiction. Notify COR of any paint specified herein which fails to conform.

1.6.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.6.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.6.4 Asbestos Content

Materials shall not contain asbestos.

1.6.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.6.6 Silica

Abrasive blast media shall not contain free crystalline silica.

1.6.7 Human Carcinogens

Materials shall not contain ACGIH 0100Doc and ACGIH 0100Doc confirmed human

carcinogens (A1) or suspected human carcinogens (A2).

1.6.8 Volatile Organic Compounds (VOC)

All coatings used in the Project shall meet BAAQMD, Architectural Coatings, Regulation 8, Rule 3, for VOC limits. MSDS to be submitted to Code JQ for pre-approval and upon project completion, MSDS of coatings shall be sent to Code JQ for compliance documentation.

1.7 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.8 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS and in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.8.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA Guide 3.

1.8.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH 0100Doc, threshold limit values.

1.9 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation.

1.9.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the COR and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.10 COLOR SELECTION

Color, texture, and pattern of wall coating systems shall be as indicated and in accordance with Section 09 06 90 COLOR SCHEDULE.

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the COR. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats, unless such tinting is not recommended by manufacturer.

1.11 LOCATION AND SURFACE TYPE TO BE PAINTED

1.11.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.11.1.1 Exterior Painting

Includes new surfaces and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

Shop painting of exterior structural steel members is included under Section 05 12 00 STRUCTURAL STEEL.

1.11.1.2 Interior Painting

Includes new surfaces and existing coated surfaces of the building and appurtenances as indicated and existing coated surfaces made bare by cleaning operations.

1.11.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed

ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

f. Surfaces in the following areas shall not be painted:

1. Connector locations as noted on the structural drawings and specifications.

1.11.3 Mechanical and Electrical Painting

Includes field coating of exterior new surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

1. Exposed exterior piping;

2. Exposed exhaust stacks above canopy

b. Do not paint the following, unless indicated otherwise:

1. New zinc-coated, aluminum, and copper surfaces under insulation

2. New aluminum jacket on piping

3. New interior ferrous piping under insulation.

1.11.4 Definitions and Abbreviations

1.11.4.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desited.

1.11.4.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.11.4.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or

mechanical means such as brushing, spraying, calendaring, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.11.4.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.11.4.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.11.4.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.11.4.7 EXT

MPI short term designation for an exterior coating system.

1.11.4.8 INT

MPI short term designation for an interior coating system.

1.11.4.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.11.4.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.11.4.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.11.4.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units at 60 degrees	Units at 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35

G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.11.4.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.11.4.14 Paint

See Coating definition.

1.11.4.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.11.4.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such

as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.2.1 Additional Requirements for Preparation of Surfaces With Existing Coatings

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

a. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.

b. The requirements specified are minimum. Comply also with the application instructions of the paint manufacturer.

c. Previously painted surfaces shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter.

d. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed.

e. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas.

f. New, proposed coatings shall be compatible with existing coatings.

3.2.2 Existing Coated Surfaces with Minor Defects

Sand, spackle, and treat minor defects to render them smooth. Minor defects are defined as scratches, nicks, cracks, gouges, spalls, alligatoring, chalking, and irregularities due to partial peeling of previous coatings.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Clean according to SSPC SP 2, SSPC SP 3. For shop applied epoxy coating, clean according to SSPC SP 6/NACE No.3. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

3.3.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

3.3.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, or non-alkaline detergent solution in

accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 6386, Appendix X2, and remove by one of the methods described therein.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

   1. Paint and Loose Particles: Remove by wire brushing.

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D 4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board

a. Surface Cleaning: Gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263.

3.5 PREPARATION OF WOOD SURFACES

3.5.1 New Wood Surfaces:

a. Wood surfaces shall be cleaned of foreign matter.

   Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the COR prior to receiving paint or other finish. Do not use water to clean uncoated wood.

b. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter in accordance with ASTM D 4444, Method A, unless

otherwise authorized.

c. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints.

d. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.

e. Cosmetic Repair of Minor Defects:

1. Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.

3.6 APPLICATION

3.6.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible

difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the COR to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with suitable thinner not more than as recommended by coating manufacturer. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.6.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.6.4 Coating Systems

a. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise by the manufacterer. Coating thickness where specified, refers to the minimum dry film thickness.

b. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

c. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces, Coat surfaces with the following:

1. One coat of primer.

2. One coat of undercoat or intermediate coat.

3. One topcoat to match adjacent surfaces.

d. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.7 COATING SYSTEMS FOR METAL

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

e. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.8 PIPING IDENTIFICATION

Piping Identification, refer to Mechanical Drawings and Specifications.

3.9 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the COR. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.10 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers. Set aside extra paint for future color matches or reuse by the Government.

3.11 PAINT TABLES

All DFT's are minimum values. Use only paints and coatings that do not exceed the VOC limits of BAAQMD.

3.12 EXTERIOR PAINT TABLES

3.12.1 Ferrous Metals

Hollow metal doors and frames, and piping systems.

MPI EXT 5.3H-G5 (Semigloss), Waterborne Primer / Latex

Primer:	MPI 134
Intermediate:	MPI 11
Topcoat:	MPI 11

System DFT: 4.5 mils

3.12.2 Structural Steel

For in-shop application to exterior members as specified in Section 05 12 00 STRUCTURAL STEEL for use in Boiler Yard. In shop application of coatings are exempt from BAAQMD VOC limits.

MPI EXT 5.1J-G6 (Gloss), Pigmented Polyurethane over epoxy primer
Primer: MPI 101
Intermediate: MPI 101
Topcoat: MPI 72
System DFT: 8.5 mils

3.12.3 Existing Galvanized Surfaces

As noted on drawings, Building N231:

a. Repaint areas of existing 'NASA blue' located at underside of existing mansard roof siding, associated sheet metal fascia, trim, gutters and pipe column supports, and sheet metal cover at window head.

b. Repaint at east facade, exterior metal wall siding, hollow metal doors and frames, overhead coiling door and frame.

MPI REX 5.3J-G5 (Semigloss), Waterborne Light Industrial Coating
Primer: MPI 134
Intermediate: N/A
Topcoat: MPI 163
System DFT: 4.5 mils

3.13 INTERIOR PAINT TABLES

3.13.1 Concrete Masonry Units

Existing, previously painted.

MPI RIN 4.2L-G3 (Eggshell), Institutional Low Odor / Low VOC Latex
Spot Primer: MPI 50
Intermediate: MPI 145
Topcoat: MPI 145
System DFT: 4 mils

3.13.2 Ferrous Metals

Hollow metal doors and frames, and other items not otherwise specified.

MPI INT 5.3J-G5 (Semigloss), Latex over waterborne primer
Primer: MPI 134
Intermediate: MPI 153
Topcoat: MPI 153
System DFT: 4 mils

3.13.3 Interior Wood Doors and Frames

MPI INT 6.3V-G5 (Semigloss), Institutional Low Odor / Low VOC Latex
Primer: MPI 39
Intermediate: MPI 147
Topcoat: MPI 147

System DFT: 4 mils

3.13.4 Gypsum Board, High-humidity areas

New and existing, previously painted wallboard in toilets, shower areas, and other high humidity areas not otherwise specified.

New: MPI INT 9.2L-G5 (Semigloss), Existing: MPI RIN 9.2L-G5 (Semigloss), Waterborne Light Industrial Coating

Primer:	MPI 50
Intermediate:	MPI 153
Topcoat:	MPI 153
System DFT:	4 mils

3.13.5 Gypsum Board

New and existing, previously painted wallboard and other areas not otherwise specified.

New: MPI INT 9.2M-G3 (Eggshell), Existing: MPI RIN 9.2M-G3 (Eggshell), Institutional Low Odor / Low VOC Latex

Primer:	MPI 50
Intermediate:	MPI 145
Topcoat:	MPI 145
System DFT:	4 mils

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SECTION 09 97 13.28

PROTECTION OF BURIED STEEL PIPING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for exterior protection tape wrapping systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fitting for Steel Water Pipelines
AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines
AWWA C215	Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines

NACE INTERNATIONAL (NACE)

NACE RP0274	High Voltage Electrical Inspection of Pipeline Coatings

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-I-631	Insulation, Electrical, Synthetic-Resin Composition, Nonrigid

1.3 DEFINITIONS

1.3.1 Coating

A continuous, uniformly thick layer formed on a surface by the mechanical application of a liquid, mastic, powdered, or extruded film material. Some types of application require elevated temperatures.

1.3.2 Coating System

One or more coatings applied to a properly prepared steel surface. If only one coating, that coating is applied directly to the steel surface; if more than one coating, each coating is applied in one operation over the previously applied and cured coating. For some applications, the first coating is a primer. Coatings of a particular system function together as a collective entity to protect the steel surface from corrosion. Coating system may be either liquid or tape applied.

1.3.3 Tape

Prefabricated laminate of plastic film backing with a homogeneous sealant layer or a pressure-sensitive adhesive layer produced in sheets, pads, or rolls wound on hollow cores. Tape applications do not require elevated temperatures.

1.3.4 Tape Coating System

One or more layers of tape applied cold over a properly prepared and primed steel surface. Tape on the primed surface protects the steel surface from corrosion.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Factory-applied coating system

Field-applied epoxy coating system

Thermosetting epoxy coating system

Polyethylene-Butyl Adhesive Coating System

Adhesive Thermoplastic Resin Coating System

Tape Coating System

Electrical-flaw detector

SD-06 Test Reports

Inspector's certificate

Submit for each inspection and test.

Field-applied epoxy coating

SD-08 Manufacturer's Instructions

Field-applied epoxy coating system

Thermosetting epoxy coating system

Electrical-flaw detector

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Tape Coating System (TCS)

Prefabricated tape with adhesive primer for use on pipe, couplings, damaged areas and fittings. The tape wrapping system shall conform to AWWA C209 and to MIL-I-631, Class I for fungus resistance, except that the fungus rating shall lie between zero and one for all specimens. The overall thickness of the tape wrap protection shall be not less than 30 mils. The tape system shall be suitable to be applied at temperatures below 50 degrees F and above 10 degrees F.

2.1.2 Adhesive Thermoplastic Resin Coating System (ATRCS)

Steel pipe factory-applied coating system conforming to AWWA C215 and coating manufacturer's instructions shall consist of a continuously extruded polyethylene coating applied on an adhesive undercoat.

2.1.3 Thermosetting Epoxy Coating System (TECS)

Factory-applied steel pipe system conforming to AWWA C213. Provide field-applied epoxy coating in accordance with manufacturer's recommendations and AWWA C213.

2.1.4 Polyethylene-Butyl Adhesive Coating System (PBACS)

Factory-applied steel pipe system of extruded butyl adhesive compound, 7 mils minimum thickness, covered with overlapping layers of extruded polyethylene wrapping, 38 mils minimum thickness, in accordance with AWWA C214.

2.1.5 Mastics

Apply a coating of manufacturer approved mastic protection to irregular surfaces. Mastic shall be compatible with coating system. Apply the tape system over mastic. Mastic layer thickness shall conform to coating manufacturer's recommendation.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 TCS

3.1.1.1 Surface Preparation

Surfaces shall be clean and dry. Wire brush weld beads, and remove weld spatters. Remove heavy rust or mill scale with wire brush.

3.1.1.2 Application

Remove paper from Kraft paper-protected material before placing in final

position. Reinforce coating at sling points with roofing felt or other approved heavy shielding material, or handle with nylon or canvas slings. Apply polyvinylchloride-butyl rubber laminated tape or pressure-sensitive organic plastic tape and its adhesive primer by single machine operation.

a. Pipe: Spirally wrap straight runs in one layer, lapping the tape as applied. Overlap shall conform to recommendations of the tape manufacturer. When an outerwrap is used, overlap of outerwrap shall bridge joints of the tape. Apply at each end of straight runs a double wrap of one full width of tape at right angles to the axis in such a manner so as to seal ends of spiral wrapping.

b. Pipe Joints and Couplings and Damaged Areas of Coatings: Clean joint areas which are to be taped, of burrs and rust. Smooth down or cut away damaged coating when not firmly bonded to pipe. Spirally wrap with a two-layer wrapping system, overlapping coating surface at least 3 inches. Initially stretch tape sufficiently to conform to the surface to which it is applied, using one layer half-lapped for tape 2 inches or less in width or one layer lapped at least one inch for tape more than 2 inches wide. Apply a second layer, lapped as above, with tension as tape comes off roll, and press to conform to shape of component. For other irregular surfaces such as bolted flanges valve bodies where tape coating system containing mastics is to be provided, apply with brush.

c. Tie Rods and Tie Rod Fittings: Spirally wrap with a two-layer coating system. Apply tape to tie rods by lapping each layer of tape using a half-lap for tape 2 inches or less in width or at least a one inchlap for tape more than 2 inches wide. For tie rod fittings, initially stretch tape sufficiently to conform to the surface to which it is applied, using one layer half-lapped for tape 2 inches or less in width or one layer lapped at least one inch for tape more than 2 inches wide. Apply a second layer, lapped as before, with a tension as tape comes off the roll, and press to conform to the shape of component.

3.1.2 Joints, and Other Irregular Surfaces For ATRCS

Prepare surface as described in paragraph entitled "TCS." Wrap tape as specified in paragraph entitled "TCS"; except, apply the tape half-lapped, and prime extruded polyethylene coating and adhesive undercoat surfaces to be tape wrapped with a compatible primer as recommended by the tape manufacturer and approved by the extruded polyethylene coating applicator for use on the polyethylene coating.

3.1.2.1 Damaged Areas

Repair damaged areas of the extruded polyethylene coating by tape wrapping as specified under the paragraph, entitled "Tape Coating System" except press residual material from the extruded polyethylene coating into the break, or trim off. Prime areas to be taped prior to applying half-lapped tape.

3.1.3 TECS

Install in accordance with the manufacturer's instructions and AWWA C213.

3.1.3.1 Joints

Clean both sides of weld area by wire brushing, and remove dust, moisture,

and other contaminants. Apply primer recommended by coating manufacturer after cleaning of joints.

3.1.3.2 Damaged Areas

Remove damaged coating by abrading, filing, or wire brushing. Clean area to be repaired free of dust, moisture, and other contaminants. Cover with a primer and a coating recommended by coating manufacturer. Apply coating over cleaned surface, and extend approximately 3 inches beyond damaged area.

3.1.4 Joints and Other Irregular Surfaces For PBACS

Clean both sides of weld area by wire brushing, and remove dust, moisture, and other contaminants. Apply primer recommended by tape manufacturer and acceptable to coating manufacturer on cleaned area. Apply tape spirally with a 50-percent overlap in accordance with the tape manufacturer's instructions.

3.1.4.1 Damaged Areas

Remove rough or protruding polyethylene from damaged area by abrading, filing, or cutting the material. Clean area to be repaired free of dust, moisture, and other contaminants. Cover with tape recommended by coating manufacturer and primer recommended by tape manufacturer. Apply primer over cleaned surface, and extend approximately 3 inches beyond damaged area. Apply tape over primer, and extend one inch beyond damaged area. Apply additional primer over tape patch. Spirally wrap additional tape around pipe with a 50-percent overlap to cover tape patch, and extend a minimum of 2 inches beyond the edge of the patch.

3.2 FIELD QUALITY CONTROL

Conform to AWWA C214 and AWWA C213. Inspection shall be performed by a National Association of Corrosion Engineers (NACE) certified inspector.

3.2.1 Field Inspection

Examine material surface preparation and application proceduresperformed in the field.

3.2.2 Field Test

Test the protective system for holes, voids, cracks, and other visually undetectable damage that may occur during handling and installation in accordance with NACE Standard NACE RP0274. In critical applications no holidays will be permitted. In non critical applications up to 3 holidays per linear feet of the pipe may be accepted. Test with an approved electrical-flaw detector in accordance with the detector manufacturer's printed instructions. Prepare inspector's certificate for each inspection and test. Repair areas where arcing occurs and retest.

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EXTERIOR SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

This section covers common types of exterior signs, dimensional building letters, and metal plaques.

1.2 GENERAL REQUIREMENTS

All exterior signage shall be provided by a single manufacturer. Exterior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Submit exterior signage schedule in electronic media with spread sheet format. Spread sheet shall include sign location, sign type, and message. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Recyclable materials shall conform to EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS. Each sample shall consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Submit three color samples for each material requiring color and 12 inch square sample of sign face color sample.

1.2.1 Wind Load Requirements

Exterior signage shall be designed to withstand current code required windloading. Submit design analysis and supporting calculations performed in support of specified signage.

1.2.2 Character Proportions and Heights

Letters and numbers on indicated signs for handicapped-accessible buildings shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings

SD-03 Product Data

Installation
Exterior Signage
Wind Load Requirements

SD-04 Samples

Exterior Signage

SD-10 Operation and Maintenance Data

Protection and Cleaning

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

PART 2 PRODUCTS

2.1 MODULAR EXTERIOR SIGNAGE SYSTEM

Exterior signage shall consist of a system of coordinated directional, identification, and regulatory type signs located where shown. Dimensions, details, materials, message content, and design of signage shall be as shown. Submit manufacturer's descriptive data and catalog cuts.

2.1.1 Panel And Post/Panel Type Signs

2.1.1.1 Posts

One-piece aluminum or galvanized steel posts shall be provided with minimum 0.125 inch wall thickness. Posts shall be designed to accept panel framing system described. The post shall be designed to permit attachment of panel framing system without exposed fasteners. Caps shall be provided for each post.

2.1.1.2 Panel Framing System

Panel framing consisting of aluminum sections and interlocking track components shall be designed to interlock with posts with concealed fasteners.

2.1.1.3 Panels

Modular message panels shall be provided in sizes shown on drawings. Panels shall be fabricated a minimum of 0.125 inch aluminum

2.1.1.4 Finishes

Post finish shall be semi-gloss baked enamel ortwo-component acrylic polyurethane. Metal panel system finish shall be baked enamel or two-component acrylic polyurethane , as shown.

2.1.1.5 Mounting

Permanent mounting shall be provided by embedding posts in concrete foundation as shown.

2.2 GRAPHICS FOR EXTERIOR SIGNAGE SYSTEMS

2.2.1 Graphics, Message and Finish

Signage graphics shall be as indicated on the Drawings

PART 3 EXECUTION

3.1 INSTALLATION

Signs, plaques, or dimensional letters shall be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings; submit drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message shall be included. Steel conduits installed underground and illuminated signage mounted directly on buildings shall be in conformance with the requirements of Section 26 05 70.00 40 HIGH VOLTAGE OVERCURRENT PROTECTIVE DEVICES. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed. Submit manufacturer's installation instructions and cleaning instructions.

3.1.1 Anchorage

Anchorage and fastener materials shall be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, Cover all project identification, directional, and other signs which may mislead the public. Covering shall be maintained until instructed to be removed by the COR or until the facility is to be opened for business. Submit six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions shall include simplified diagrams for the equipment as installed. Signs shall be cleaned, as required, at time of cover removal.

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SECTION 10 22 13

WIRE MESH PARTITIONS

PART 1 GENERAL

1.1 SUMMARY

This section covers wire mesh partitions for normal and for extra heavy industrial use. Partitions and partition anchors must be designed to comply with minimum requirements of the California Building Code.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG03-3	Cold-Formed Steel Design Manual Set

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	Standard Specification for Carbon Structural Steel

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wire mesh partitions

Show layout, details, materials, dimensions, finishes, and all information necessary for fabrication and installation.

SD-03 Product Data

Wire mesh partitions

Submit for each type of partition and door.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials in manufacturer's original, unopened containers or packaging with labels intact and legible. Deliver, store, and handle materials so as to prevent damage. Replace damaged or defective materials

with new.

1.5 DESCRIPTION OF WORK

Provide manufacturer's standard and/or modular components for Wire mesh partitions, which shall be all wire type, normal duty for normal industrial use, and shall be provided complete with fasteners, capping bars, adjustable floor sockets, bracing, doors, hardware, and other items necessary for a complete, useable, and rigid installation.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Shapes, Plates, and Bars

ASTM A36/A36M.

2.1.2 Cold-Formed Steel

AISI SG03-3.

2.1.3 Wire Mesh

Carbon steel wire, woven square or diamond mesh, intermediate crimped.

2.1.4 Floor Sockets

Cast or forged steel or ductile iron, adjustable, approximately 2-1/2 inches high.

2.2 NORMAL DUTY PARTITIONS

2.2.1 Wire Mesh

10 gage wire, 1-1/2 inch mesh.

2.2.2 Vertical Frames

1-1/4 by 5/8 inch cold-rolled C section channels or 1-1/4 by 5/8 by 1/8 inch channels.

2.2.3 Horizontal Frames

1 by 5/8 inch channels.

2.2.4 Center Reinforcing Bar

One 1 by 1/2 by 1/8 inch channel with all wires woven through, or two 1 by 3/8 by 1/8 inch channels bolted together with mesh in between.

2.2.5 Capping Bar

2-1/4 by one by 1/8 inch channel or 2 by 1/4 inch flat bar.

2.2.6 Corner Posts

Structural steel angles, 1-1/4 by 1-1/4 by 1/8 inch.

2.2.7 Line Posts

Provide manufacturer's standard post, sized for height and width of panel and configuration of wire mesh enclosure.

2.2.8 Hinged Doors

Frames shall be 1-1/4 by 1/2 by 1/8 inch channels with 1-1/4 by 1/8 inch flat bar cover on top and bottom rails and on hinge stile and a 1-3/8 by 3/4 by 1/8 inch angle riveted to the lock stile.

At single leaf doors, provide 1 1/2 pairs of regular weight, wrought steel, non-removable pin, butt hinges riveted or welded to the door and the door opening frame. Coordinate with Section 08 71 00, DOOR HARDWARE, to provide 14 ga lock case securely mounted to door frame to receive specified mortise lockset with separate card reader, and other hardware accessories.

At double leaf doors, provide 3 pairs of regular weight, wrought steel, non-removable pin, butt hinges riveted or welded to the door and the door opening frame. Coordinate with Section 08 71 00, DOOR HARDWARE, to provide 14 ga lock case securely mounted to door frame to receive specified mortise lockset and other hardware accessories.

2.3 DOOR OPENING FRAMES

Provide frames the same size and shape as the vertical frames for the mesh panels.

2.4 LOCKS AND HARDWARE

Provide lock case as needed for locks specified in Section 08 71 00, DOOR HARDWARE for swinging doors.

2.5 FABRICATION

2.5.1 Standard Panels

Wire shall be woven into square or diamond mesh, intermediate crimped, and securely clinched to frames. Joints shall be mortised and tenoned. Wire shall be continuous at center reinforcing bars, either woven through a single channel or bolted between two channels. Panel vertical frames shall have 1/4 inch bolt holes 12 inches o.c. for normal duty partitions.

2.5.2 Doors

Construction shall be similar to that specified for panels. Wire mesh shall be the same as that used in the adjacent partition panels.

2.5.3 Finish

Thoroughly clean ferrous metal, treat with phosphate, and paint with electrostatic gray baked enamel in the shop.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wire Mesh Partitions

Prior to installation of wire mesh partition, review field conditions and locate positions of all floor anchoring points per approved shop drawings. Confirm that such anchoring points are not on, nor within 12 inches of the edge of existing metal floor trench cover plates. Inform COR if position of anchor point do not conform to this criteria. Do not proceed with installation until such deficiency is addressed.

Install plumb, level, and true to line, within a tolerance of 1/8 inch in 10 feet or the height or run of the partition, if less than 10 feet. Anchor floor sockets to the floor with expansion bolts. Vertical frames and posts shall be bolted together with 1/4 inch bolts 12 inches o.c. for normal duty partitions. Secure top frames to a continuous capping bar with 1/4 inch diameter U bolts not more than 28 inches o.c.

3.1.2 Doors

Install in accordance with the manufacturers' recommendations. Adjust as required so that doors and hardware operate freely and properly.

3.1.3 Bracing

Brace free standing partitions more than 20 feet in length, at intervals not greater than 20 feet with a structural steel I section or tube post welded to a 9 by 9 inch steel base plate anchored to the floor with 4 expansion bolts or as indicated.

3.1.4 Touch-Up

Clean and paint scratches, abrasions, and other damage to shop painted surfaces to match the shop-applied finish.

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SECTION 10 28 13

TOILET ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

This section covers toilet accessories suitable for a wide variety of applications.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM C 1036 Standard Specification for Flat Glass

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Finishes

Accessory Items

SD-04 Samples

Finishes

SD-07 Certificates

Accessory Items

1.4 DELIVERY, STORAGE, AND HANDLING

Wrap toilet accessories for shipment and storage, then deliver to the jobsite in manufacturer's original packaging, and store in a clean, dry area protected from construction damage and vandalism.

1.5 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

Provide toilet accessories as shown on drawings. Provide each accessory item complete with the necessary mounting plates of sturdy construction with corrosion resistant surface.

2.1.1 Anchors and Fasteners

Provide anchors and fasteners capable of developing a restraining force commensurate with the strength of the accessory to be mounted and suited for use with the supporting construction. Provide oval heads exposed fasteners with finish to match the accessory.

2.1.2 Finishes

Except where noted otherwise, provide the following finishes on metal:

Metal	Finish
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, bright

2.2 ACCESSORY ITEMS

Conform to the requirements for accessory items specified below. Submit fasteners proposed for use for each type of wall construction, mounting, operation, and cleaning instructions and one sample of each other accessory proposed for use. Submit certificate for each type of accessory specified, attesting that the items meet the specified requirements.

2.2.1 Grab Bar (GB)

Provide an 18 gauge, 1-1/4 inch grab bar OD Type 304 stainless steel. Provide form and length for grab bar as indicated. Provide exposed mounting flange. Provide grab bar with satin finish. Furnish installed bars capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious permanent deformation. Allow 1-1/2 inch space between wall and grab bar.

2.2.2 Mirrors, Glass (MG)

Provide Type I transparent flat type, Class 1-clear glass for mirrors. Glazing Quality 1, 1/4 inch thick conforming to ASTM C 1036. Coat glass on one surface with silver coating, copper protective coating, and mirror backing paint. Provide highly adhesive pure silver coating of a thickness which provides reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, free of pinholes or other defects. Provide copper protective coating with pure bright reflective copper, homogeneous without sludge, pinholes or other defects, of proper thickness to prevent "adhesion pull" by mirror backing paint. Provide mirror backing paint with two coats of special scratch and abrasion-resistant paint and baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.2.3 Soap Dispenser (SD)

Provide soap dispenser with view window, surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 40 fluid ounces with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps.

2.2.4 Soap Holder (SH)

Provide surface mounted Type 304 stainless steel soap holder. Provide stainless steel separate supports.

2.2.5 Shelf, Metal, Light Duty (SMLD)

Support light duty metal shelf between brackets or on brackets. Purpose of brackets is to prevent lateral movement of the shelf. Furnish 18 inch long shelf. Provide stainless steel shelf and brackets.

2.2.6 Towel Pin (TP)

Provide towel pin with concealed wall fastenings, and a pin integral with or permanently fastened to wall flange with maximum projection of 4 inch. Provide satin finish.

2.2.7 Toilet Tissue Dispenser, Jumbo (TTDJ)

Provide surface mounted toilet tissue dispenser with 2 rolls of jumbo tissue. Fabricate cabinet of high-impact plastic body and transparent plastic front cover. Provide cover with key lock.

2.2.8 Waste Receptacle (WR)

Provide Type 304 stainless steel waste receptacle, designed for surface mounting. Provide reusable liner, of the type standard with the receptacle manufacturer. Provide a minimum 6.4 gallon capacity.

2.2.9 Toilet Seat Cover Dispenser (TSCD)

Provide Type 304 stainless steel with surface mounted toilet seat cover dispensers. Provide dispenser with a minimum capacity of 250 seat covers.

2.2.10 Folding Shower Seat (FSS)

Folding shower seat shall have a frame constructed of type-304 satin finish stainless steel, 16-gauge, 1-1/4 inch square tubing, and 18-gauge, 1 inch diameter seamless tubing. Seat shall be constructed of one-piece, 1/2 inch thick water-resistant, ivory colored solid phenolic with black edge. Clearance between back of shower seat and wall shall be 1-1/2 inches to comply with ADA Accessibility Guidelines (ADAAG). Seat supports shall not come into contact with the floor. Seat shall be able to lock in upright position when not in use. Seat shall be attached to wall by two 3 inch diameter mounting flanges constructed of type-304, 3/16 inch thick stainless steel with satin finish. Manufacturer's service and parts manual shall be provided to building owner/manager upon completion of project.

PART 3 EXECUTION

3.1 INSTALLATION

Provide the same finish for the surfaces of fastening devices exposed after installation as the attached accessory. Provide oval exposed screw heads. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. Use sealants for brackets, plates, anchoring devices and similar items in showers (a silicone or polysulfide sealant) as they are set to provide a watertight installation. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Conceal fasteners on accessories without backplates. Install accessories with sheet metal screws or wood screws in lead-lined braided jute, teflon or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood studs or to solid wood blocking secured between wood studs, or to metal backplates secured to metal studs.

3.2 CLEANING

Clean material in accordance with manufacturer's recommendations. Do not use alkaline or abrasive agents. Take precautions to avoid scratching or marring exposed surfaces.

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-- End of Section Table of Contents --

SECTION 10 44 16

FIRE EXTINGUISHERS

PART 1 GENERAL

1.1 SUMMARY

This section covers portable fire extinguishers, including wall brackets, cabinets, accessories, maintenance servicing and inspection tagging requirements.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1	Fire Code
NFPA 10	Standard for Portable Fire Extinguishers
NFPA 101	Life Safety Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.157	Portable Fire Extinguishers

UNDERWRITERS LABORATORIES (UL)

UL 299	Dry Chemical Fire Extinguishers

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Manufacturer's Data for each type of required Fire Extinguisher with all related details, cabinets, accessories, and recommended operation manuals.

SD-02 Shop Drawings

Submit fabrication drawings for the following items consisting of fabrication and assembly details performed in the factory. Submit installation drawings for the following items in accordance with

the paragraph entitled, "Installation," of this section.

Fire Extinguishers
Accessories
Wall Brackets

SD-03 Product Data

Submit Manufacturer's catalog and warranty data for the following items:

Fire Extinguishers
Accessories
Wall Brackets
Replacement Parts

SD-04 Samples

Three samples of Wall Brackets and Accessories of each type being used

Approved samples may be used for installation, with proper identification and storage.

SD-07 Certificates

Submit Certificates showing the following:

Certification that Fire Extinguishers comply with local codes and regulations.

Certification that Fire Extinguishers comply with OSHA, NFPA, and UL requirements.

Submit Manufacturer's Warranty with Inspection Tag on each extinguisher.

Guarantee that Fire Extinguishers are free of defects in materials, fabrication, finish, and installation and that they will remain so for a period of not less than 5 years after completion.

1.4 DELIVERY, HANDLING, AND STORAGE

Protect materials from weather, soil, and damage during delivery, storage, and construction.

Deliver materials in their original packages, containers, or bundles bearing the brand name and the name and type of the material.

PART 2 PRODUCTS

2.1 TYPES

Provide Fire Extinguishers conforming to NFPA 10. Provide quantity and placement in compliance with the applicable sections of ICC IFC, Section 1414 and ICC IFC, Section 906, NFPA 1, NFPA 101, and 29 CFR 1910.157.

Provide stored-pressure water type fire extinguishers.

Provide 40BC dry chemical type fire extinguishers compliant with UL 299.

Submit Manufacturer's Data for each type of Fire Extinguishers required, detailing all related Wall Mounting and Accessories information, complete with Manufacturer's Warranty with Inspection Tag.

2.2 MATERIAL

Provide corrosion-resistant steel extinguisher shell.

2.3 SIZE

10 pounds extinguishers.

2.4 ACCESSORIES

Safety release

Pressure gage

2.5 WALL BRACKETS

Provide wall bracket and accessories as approved.

PART 3 EXECUTION

3.1 INSTALLATION

Install Fire Extinguishers where indicated on the drawings. Install fire extinguishers in full compliance with the California Fire Code and the California Building Code. Verify exact locations prior to installation.

Comply with the manufacturer's recommendations for all installations.

Provide extinguishers which are fully charged and ready for operation upon installation. Provide extinguishers complete with Manufacturer's Warranty with Inspection Tag attached.

3.2 ACCEPTANCE PROVISIONS

3.2.1 Repairing

Remove and replace damaged and unacceptable portions of completed work with new work at no additional cost to the Government.

Provide Replacement Parts list indicating specified items replacement part, replacement cost, and name, address and contact for replacement parts distributor.

3.2.2 Cleaning

Clean all surfaces of the work, and adjacent surfaces which are soiled as a result of the work. Remove from the site all construction equipment, tools, surplus materials and rubbish resulting from the work.

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SECTION 12 21 00

WINDOW BLINDS

PART 1 GENERAL

1.1 SUMMARY

This section covers window blinds and hardware.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701	Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

SD-03 Product Data

Window Blinds

Installation

SD-04 Samples

Window Blinds

SD-06 Test Reports

Window Blinds

SD-08 Manufacturer's Instructions

Window Blinds

SD-10 Operation and Maintenance Data

Window Blinds

1.4 SYSTEM DESCRIPTION

Provide window treatment, conforming to NFPA 701, complete with necessary brackets, fittings, and hardware. Each window treatment type shall be a complete unit. Mount and operate equipment in accordance with manufacturer's instructions. Windows to receive a treatment shall be completely covered.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver components to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated and free from dust, water, or other contaminants and has easy access for inspection and handling. Store materials flat in a clean dry area with temperature maintained above 50 degrees F. Do not open containers until needed for installation unless verification inspection is required.

1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 WINDOW BLINDS

Provide each blind, including hardware, accessory items, mounting brackets and fastenings, as a complete unit produced by one manufacturer. All parts shall be one color, unless otherwise indicated, to match the color of the blind slat. Treat steel features for corrosion resistance.

2.1.1 Horizontal Blinds

Provide horizontal blinds with 1 inch slats. Blind units shall be capable of nominally 180 degree partial tilting operation and full-height raising. Blinds shall be inside mount. Tapes for 1 inch slats shall be braided polyester or nylon.

2.1.1.1 Head Channel and Slats

Provide head channel made of steel or aluminum with corrosion-resistant finish nominal 0.024 inch for 1 inch slats. Provide slats of aluminum, not less than 0.008 inch thick, and of sufficient strength to prevent sag or bow in the finished blind. Provide a sufficient amount of slats to assure proper control, uniform spacing, and adequate overlap. Enclose all hardware in the headrail.

2.1.1.2 Controls

The slats shall be tilted by a transparent tilting wand, hung vertically by its own weight, and shall swivel for easy operation. Provide a tilter control of enclosed construction. Provide moving parts and mechanical drive made of compatible materials which do not require lubrication during normal expected life. The tilter shall tilt the slats to any desited angle and hold them at that angle so that any vibration or movement of ladders

and slats will not drive the tilter and change the angle of slats. Include a mechanism to prevent over tightening. Provide a wand of sufficient length to reach to within 5 feet of the floor.

2.1.1.3 Intermediate Brackets

Provide intermediate brackets for installation, as recommended by the manufacturer, of blinds over 48 inch wide.

2.1.1.4 Bottom Rail

Provide bottom rail made of corrosion-resistant steel with factory applied finish. Provide closed oval shaped bottom rail with double-lock seam for maximum strength. Bottom rail and end caps to match slats in color.

2.2 COLOR

Provide color, pattern and texture as selected from manufacturer's standard colors by COR.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify all dimensions in the field, and advise the COR of any discrepancy before performing the work.

3.2 INSTALLATION

Submit drawings showing fabrication and installation details. Show layout and locations of track, direction of draw, mounting heights, and details.

3.2.1 Horizontal Blinds

Perform installation of Horizontal Blinds in accordance with the approved detail drawings and manufacturer's installation instructions. Install units level, plumb, secure, and at proper height and location relative to window units. Provide and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Do not start installation until completion of room painting and finishing operations.

3.3 CLEAN-UP

Upon completion of the installation, free window treatments from soiling, damage or blemishes; and adjust them for form and appearance and proper operating condition. Repair or replace damaged units as directed by the COR. Isolate metal parts from direct contact with concrete, mortar, or dissimilar metals. Ensure blinds installed in recessed pockets can be removable without disturbing the pocket. The entire blind, when retracted, shall be contained behind the pocket. For blinds installed outside the jambs and mullions, overlap each jamb and mullion 0.75 inch or more when the jamb and mullion sizes permit. Include all hardware, brackets, anchors, fasteners, and accessories necessary for a complete, finished installation.

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SECTION 13 48 00.00 10

SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

This section covers seismic protection of mechanical equipment, building piping, and exterior utilities.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1650	Seismic Restraint Manual Guidelines for Mechanical Systems, 2nd Edition

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

Apply the requirements for seismic protection measures described in this section to the mechanical equipment and systems listed below. Structural requirements shall be in accordance with Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

1.3.2 Mechanical Equipment

Mechanical equipment to be seismically protected shall include the following items to the extent required on the drawings or in other sections of these specifications:

a. Boilers

b. Storage Tanks for Water

c. Water Heaters

d. Steam, Water, and Gas Piping

e. Valves and Fittings for Piping

f. Heat Exchangers

g. Refrigerant Compressors

h. Air Handling Units

i. Pumps with Motors

j. Pollution Control Equipment

k. Ducts

l. Flash Tanks

m. Exhaust and Return Fans

n. Deaerator Heater and Feedwater Tank

1.3.3 Mechanical Systems

Install the following mechanical systems as required on the drawings and other sections of these specifications, and seismically protect them in accordance with the drawings and this specification:

a. All Piping Inside the Building or Boiler Plant Except as Specifically Stated Below Under "Items Not Covered By This Section".

b. Fuel Piping.

c. All Water Supply Systems.

d. All Process Piping.

e. Heat Distribution Systems (Supply, Return, and Condensate Return)

f. Water Storage Tanks.

1.3.4 Contractor Designed Bracing

Submit copies of the design calculations with the drawings. Calculations shall be approved, certified, stamped and signed by a registered Professional Engineer licensed in the State of California. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace. Design the bracing in accordance with ASCE-7 and additional data furnished by the COR. Design pipe supports and bracing in accordance with loads developed in pipe stress analysis. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. The bracing design for the following mechanical equipment and systems shall be developed by the Contractor: Design-build piping as noted on drawings.

1.3.5 Items Not Covered By This Section

1.3.5.1 Items Requiring No Seismic Restraints

Seismic restraints are not required for the following items:

a. Rectangular HVAC ducts less than 6 square feet in cross sectional area.

b. Ducts suspended by hangers 12 inches or less in length from the top of

the duct to the bottom of the supporting structural member, except as noted below. All hangers shall meet the length requirements. If the length requirement is exceeded by one hanger in the run, the entire run shall be braced. Piping and ducts not listed above shall be seismically protected in accordance with the provisions of this specification.

1.4 EQUIPMENT REQUIREMENTS

Submit copies of the design calculations with the detail drawings. Calculations shall be stamped by a California registered engineer licensed in the State of California and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Coupling and Bracing
Flexible Couplings or Joints
Equipment Requirements
Contractor Designed Bracing.

SD-03 Product Data

Coupling and Bracing
Equipment Requirements
Contractor Designed Bracing.

PART 2 PRODUCTS

2.1 FLEXIBLE MECHANICAL JOINTS

a. Mechanical couplings for steel pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.

b. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets.

2.2 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 COUPLING AND BRACING

a. Submit detail drawings, as specified here and throughout this specification, along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the construction of boiler facility structure.

b. Coupling installation shall conform to the details shown on the drawings. Provisions of this paragraph apply to all piping within a 5 foot line around outside of boiler facility structure unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the most frequent interval as determined by applying the requirements of this specification to each piping run on the common support.

c. Bracing components shall be sized as required for the total load carried by the common supports. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

3.2 SPREADERS

Spreaders shall be provided between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart. Spreaders shall be applied at same interval as sway braces at an equal distance between the sway braces. If rack type hangers are used where the pipes are restrained from contact by mounting to the rack, spreaders are not required for pipes mounted in the rack. Spreaders shall be applied to surface of bare pipe and over insulation on insulated pipes utilizing high-density inserts and pipe protection shields in accordance with the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.3 SWAY BRACES FOR PIPING

Sway braces shall be provided to prevent movement of the pipes under seismic loading. Braces shall be provided in both the longitudinal and transverse directions, relative to the axis of the pipe. The bracing shall not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications.

3.3.1 Transverse Sway Bracing

Transverse sway bracing for steel and copper pipe shall be provided as specified in Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT. All runs (length of pipe between end joints) shall have a minimum of two transverse braces.

3.3.2 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided unless otherwise indicated. All runs (length of pipe between end joints) shall have one longitudinal brace minimum. Sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be used as sway braces.

3.3.3 Vertical Runs

Run is defined as length of pipe between end joints. Vertical runs of piping shall be braced at not more than 10 foot vertical intervals. Braces for vertical runs shall be above the center of gravity of the segment being braced. All sway braces shall be constructed in accordance with the drawings. Sway braces shall attach to the structural system and shall not be connected to branch lines, walls, or floors.

3.3.4 Clamps and Hangers

Clamps or hangers on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps or hangers applied over insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.4 SWAY BRACES FOR HVAC DUCTS

3.4.1 Unbraced Ducts

Hangers for unbraced ducts shall be attached to the duct within 2 inches of the top of the duct with a minimum of two #10 sheet metal screws in accordance with SMACNA 1650. Unbraced ducts shall be installed with a 6 inch minimum clearance to vertical ceiling hanger wires.

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SECTION 13 48 00

SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

This section covers seismic structural elements for protection of mechanical, electrical and miscellaneous equipment.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-05	Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A500/A500M	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A572/A572M	Standard Specification for High-Strength

	Low-Alloy Columbium-Vanadium Structural Steel
ASTM A603	Standard Specification for Zinc-Coated Steel Structural Wire Rope
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E 488	Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

CALIFORNIA CODE OF REGULATIONS (CCR)

CBC	California Building Code

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

Apply the requirements for seismic protection measures, described in this section, to the mechanical equipment and systems outlined in Section 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT, the electrical equipment and systems outlined in Section 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT, and the miscellaneous equipment and systems listed below, in accordance with ASCE 7-05 and CBCand additional data furnished by the COR. Provide seismic protection measures in addition to any other requirements called for in other sections of these specifications. The design for seismic protection shall be based on a occupancy category IV and on site response coefficients for S_{MS} = 1.5 and S_{M1} = 0.9 Accomplish resistance to lateral forces induced by earthquakes without consideration of friction resulting from gravity loads.

1.4 EQUIPMENT REQUIREMENTS

Submit detail drawings, as specified here and throughout this specification, along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall: be complete in detail; indicate thickness, type, grade, class of metal, and dimensions; and show construction details, reinforcement, anchorage, and installation with relation to the building construction. T he drawings shall be stamped by the California registered engineer licensed in the State of California who stamps the calculations required above. Submit copies of the design calculations with the detail drawings. Calculations shall be stamped, by a California registered engineer licensed in the State of California, and verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Bracing
Resilient Vibration Isolation Devices

Equipment Requirements

SD-03 Product Data

Bracing
Equipment Requirements

SD-06 Test Reports

Anchor Bolts

PART 2 PRODUCTS

2.1 BOLTS AND NUTS

Squarehead and hexhead bolts, and heavy hexagon nuts, ASTM A307 for bolts and ASTM A563 for nuts and ASTM A325 for bolts and nuts. Provide bolts and nuts galvanized in accordance with ASTM A153/A153M when used underground and/or exposed to weather.

2.2 SWAY BRACING

Material used for members listed in this section and on the drawings, shall be structural steel conforming with the following:

a. Plates, rods, and rolled shapes, ASTM A36/A36M or ASTM A572/A572M, Grade 503. If the Contractor does the design, both ASTM A36/A36Mand ASTM A572/A572M, grade 503 will be allowed.

b. Wire rope, ASTM A603.

c. Tubes, ASTM A500/A500M, Grade B .

d. Pipes, ASTM A53/A53M, Type E or S, Grade B.

e. Light gauge angles, less than 1/4 inch thickness, ASTM A653/A653M.

PART 3 EXECUTION

3.1 BRACING

Provide bracing conforming to the arrangements shown. Secure trapeze-type hanger with not less than two 1/2 inch bolts.

3.2 BUILDING DRIFT

Sway braces for a piping run shall not be attached to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided.

3.3 ANCHOR BOLTS

Submit copies of test results to verify the adequacy of the specific anchor and application, as specified.

3.3.1 Cast-In-Place

Use cast-in-place anchor bolts, conforming to ASTM A307, for floor or pad mounted equipment, except as specified below. Provide one nut on each

bolt. Anchor bolts shall have an embedded straight length equal to at least 12 times nominal diameter of the bolt. Anchor bolts that exceed the normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation or be increased in depth to accommodate bolt lengths.

3.3.2 Expansion or Chemically Bonded Anchors

Do not use expansion or chemically bonded anchors: 1) Unless test data in accordance with ASTM E 488 and ICC-ESR Report has been provided to verify the adequacy of the specific anchor and application. 2) To resist pull-out in overhead and wall installations if the adhesive is manufactured with temperature sensitive epoxies and the location is accessible to a building fire. Install expansion and chemically bonded anchors in accordance with the manufacturer's recommendations. Adjust the allowable forces for the spacing between anchor bolts and the distance between the anchor bolt and the nearest edge, as specified by the manufacturer.

3.3.2.1 General Testing

Test in place expansion and chemically bonded anchors not more than 24 hours after installation of the anchor, conducted by an independent testing agency; testing shall be performed on random anchor bolts as described below.

3.3.2.2 Torque Wrench Testing

Perform torque wrench testing on not less than 50 percent of the total installed expansion anchors and at least one anchor for every piece of equipment containing more than two anchors. The test torque shall equal the minimum required installation torque as required by the bolt manufacturer. Calibrate torque wrenches at the beginning of each day the torque tests are performed. Recalibrate torque wrenches for each bolt diameter whenever tests are run on bolts of various diameters. Apply torque between 20 and 100 percent of wrench capacity. Reach the test torque within one half turn of the nut, except for 3/8 inch sleeve anchors which shall reach their torque by one quarter turn of the nut. If any anchor fails the test, test similar anchors not previously tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified torque; if the anchor still fails the test it shall be replaced.

3.3.2.3 Pullout Testing

Test chemically bonded anchors by applying a pullout load using a hydraulic ram attached to the anchor bolt. At least 5 percent of the anchors, but not less than 3per day shall be tested. Apply the load to the anchor without removing the nut; when that is not possible, the nut shall be removed and a threaded coupler shall be installed of the same tightness as the original nut. Check the test setup to verify that the anchor is not restrained from withdrawing by the baseplate, the test fixture, or any other fixtures. The support for the testing apparatus shall be at least 1.5 times the embedment length away from the bolt being tested. Load each tested anchor to 1 time the design tension value for the anchor. The anchor shall have no observable movement at the test load. If any anchor fails the test, similar anchors not previously tested shall be tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified load; if the anchor still fails the test it shall be replaced.

3.4 RESILIENT VIBRATION ISOLATION DEVICES

Where the need for these devices is determined, based on the magnitude of the design seismic forces, selection of anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS, except that an equipment weight equal to five times the actual equipment weight shall be used.

3.4.1 Resilient and Spring-Type Vibration Devices

Select vibration isolation devices so that the maximum movement of equipment from the static deflection point is 1/2 inch.

3.5 SWAY BRACES FOR PIPING

Provide transverse sway bracing for steel and copper pipe at intervals not to exceed those shown on the drawings.

3.5.1 Longitudinal Sway Bracing

Provide longitudinal sway bracing in accordance with Section 13 48 00.00 10 SEISMIC CONTROL FOR MECHANICAL EQUIPMENT.

3.5.2 Anchor Rods, Angles, and Bars

Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in the tabulation below.

3.5.3 Maximum Length for Anchor Braces

Type	Size (Inches)	Maximum Length* (Feet/Inches)
Angles	1-1/2 x 1-1/2 x 1/4	4-10
	2 x 2 x 1/4	6-6
	2-1/2 x 1-1/2 x 1/4	8-0
	3 x 2-1/2 x 1/4	8-10
	3 x 3 x 1/4	9-10
Rods	3/4	3-1
	7/8	3-8
Flat Bars	1-1/2 x 1/4	1-2
	2 x 1/4	1-2
	2 x 3/8	1-9
Pipes (40S)	1	7-0
	1-1/4	9-0
	1-1/2	10-4
	2	13-1

3.5.4 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 1/2 inch diameter.

3.6 EQUIPMENT SWAY BRACING

3.6.1 Suspended Equipment and Light Fixtures

Provide equipment sway bracing for items supported from overhead floor or roof structural systems, including light fixtures. Braces shall consist of angles, rods, wire rope, bars, or pipes arranged as shown and secured at both ends with not less than 1/2 inch bolts. Provide sufficient braces for equipment to resist a horizontal force as specified in ASCE 7-05 without exceeding safe working stress of bracing components. Provide, for approval, specific force calculations in accordance with ASCE 7-05 for the equipment in the project. Submit details of equipment bracing for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

3.6.2 Floor or Pad Mounted Equipment

3.6.2.1 Shear Resistance

Bolt to the floor, floor mounted equipment. Requirements for the number and installation of bolts to resist shear forces shall be in accordance with paragraph ANCHOR BOLTS.

3.6.2.2 Overturning Resistance

Use the ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads to determine if overturning forces need to be considered in the sizing of anchor bolts. Provide calculations to verify the adequacy of the anchor bolts for combined shear and overturning.

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SECTION 22 00 00

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SECTION 22 00 00

PLUMBING, GENERAL PURPOSE

PART 1 GENERAL

1.1 SUMMARY

This section covers general purpose plumbing systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22/CSA 4.4	Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1010	Performance Requirements for Water Hammer Arresters (ANSI approved 2004)
ASSE 1018	Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied (ANSI Approved 2002

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084	Standard Methods for the Examination of Water and Wastewater
AWWA B300	Hypochlorites
AWWA B301	Liquid Chlorine
AWWA C606	Grooved and Shouldered Joints
AWWA C651	Standard for Disinfecting Water Mains
AWWA C652	Disinfection of Water-Storage Facilities

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	Specification for Filler Metals for Brazing and Braze Welding

ASME INTERNATIONAL (ASME)

ASME A112.19.2/CSA B45.1	Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
ASME A112.19.3/CSA B45.4	Stainless Steel Plumbing Fixtures
ASME A112.36.2M	Cleanouts
ASME A112.6.1M	Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.6.3	Standard for Floor and Trench Drains
ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ASME B16.18	Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.29	Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.3	Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B31.5	Refrigeration Piping and Heat Transfer Components

ASTM INTERNATIONAL (ASTM)

ASTM A105/A105M	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A193/A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A515/A515M	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and

	Lower-Temperature Service
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A733	Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A74	Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A888	Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B117	Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM B306	Standard Specification for Copper Drainage Tube (DWV)
ASTM B32	Standard Specification for Solder Metal
ASTM B813	Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B88	(Standard Specification for Seamless Copper Water Tube
ASTM B88M	Standard Specification for Seamless Copper Water Tube (Metric)
ASTM C 564	Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	Standard Specification for Elastomeric Joint Sealants
ASTM D 2822	Asphalt Roof Cement
ASTM D 3139	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM E 1	Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM F 477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015	Copper Tube Handbook

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO PS 117	Press Type Or Plain End Rub Gasketed W/ Nail CU & CU Alloy Fittings 4 Install On CU Tubing
IAPMO Z124.1.2	Plastic Bathtub and Shower Units

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1	Accessible and Usable Buildings and Facilities

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z358.1	American National Standard for Emergency Eyewash and Shower Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
MSS SP-80	Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	Class 3000 Steel Pipe Unions Socket Welding and Threaded

NSF INTERNATIONAL (NSF)

NSF/ANSI 61	Drinking Water System Components - Health

Effects

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201	Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508	Hose Clamp Specifications

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SM 9223	Enzyme Substrate Coliform Test
Energy Star	Energy Star Energy Efficiency Labeling System
PL 93-523	Safe Drinking Water Act

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 141.80	National Primary Drinking Water Regulations; Control of Lead and Copper; General Requirements
PL 109-58	Energy Policy Act of 2005 (EPAct05)

UNDERWRITERS LABORATORIES (UL)

UL 499	Electric Heating Appliances

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fixtures;

List of installed fixtures with manufacturer, model, and flow rate.

Flush valve water closets

Flush valve urinals

Wall hung lavatories

Water heaters

Shower Faucets

Plumbing System

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-07 Certificates

Materials and Equipment

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

SD-10 Operation and Maintenance Data

Plumbing System

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.4.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.4.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.4.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.4.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the COR.

1.4.4.1 Definitions

For the Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "COR." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.4.4.2 Administrative Interpretations

For Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the Codes to sections of Chapter 1, shall be applied appropriately by the COR as authorized by his administrative cognizance and the FAR.

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the COR. Replace damaged or defective items.

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with CPC . Energy consuming products and systems shall be in accordance with PL 109-58 and ASHRAE 90.1 - IP

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the COR of any discrepancy before performing any work.

1.8 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, controls, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 Materials

Materials for various services shall be in accordance with TABLES I and II. Steel pipe shall contain a minimum of 100 percent recycled content, with a minimum of 67 percent post-consumer recycled content. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF/ANSI 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, or under concrete floor slabs. Cast-iron pipe shall contain a minimum of 100 percent recycled content.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310

b. Coupling for Steel Pipe: AWWA C606.

c. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.

d. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

e. Solder Material: Solder metal shall conform to ASTM B32.

f. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.

g. PTFE Tape: PTFE Tape, for use with Threaded Pipe.

h. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.

i. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.

j. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105/A105M. Blind flange material shall conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193/A193M.

k. Press fittings for Copper Pipe and Tube: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for copper press fittings shall be FKM or HNBR. Sealing elements shall be factory installed or an alternative supplied fitting manufacturer. Sealing element shall be selected based on manufacturer's approved application guidelines.

l. Copper tubing shall conform to ASTM B88, Type L indoor and Type K outdoor.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201. Water hammer arrester shall be diaphragm or piston type.

b. Asphalt Roof Cement: ASTM D 2822.

c. Hose Clamps: SAE J1508.

d. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

e. Metallic Cleanouts: ASME A112.36.2M.

f. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

g. Hypochlorites: AWWA B300.

h. Liquid Chlorine: AWWA B301.

i. Thermometers: ASTM E 1. Mercury shall not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Valves shall conform to the following standards:

Description	Standard
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110

Description	Standard
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22/CSA 4.4

2.3.1 Relief Valves

Water heaters shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22/CSA 4.4. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.3.2 Thermostatic Mixing Valves

Provide thermostatic mixing valve for shower. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desited temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 5 degrees F of any setting.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with CPC. Fixtures for use by the physically handicapped shall be in accordance with ICC/ANSI A117.1. ASME A112.19.3/CSA B45.4 302 stainless steel Vitreous China, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if

the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years shall be copper alloy with all visible surfaces chrome plated. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature.

2.4.1 Flush Valve Water Closets

ASME A112.19.2/CSA B45.1, white vitreous china, siphon jet, elongated bowl, wall mounted, wall outlet. Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for wheelchair water closets. Provide wax bowl ring including plastic sleeve. Provide white solid plastic elongated open-front seat with anti-microbial coating.

Water flushing volume of the water closet and flush valve combination shall not exceed1.6 gallons per flush.

Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve shall not interfere with the hand rail in ADA stalls.

2.4.2 Flush Valve Urinals

ASME A112.19.2/CSA B45.1, white vitreous china, ,wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 24 inches above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 0.125 gallons per flush. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture.

2.4.3 Wall Hung Lavatories

ASME A112.19.2/CSA B45.1, white vitreous china, ,straight back type, minimum dimensions of 19 inches, wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets, and openings for concealed arm carrier installation. Provide aerator with faucet. Water flow rate shall not exceed 0.5 gpm when measured at a flowing water pressure of 60 psi. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatory with the front rim 34 inches above floor and with 29 inches minimum clearance from bottom of the front rim to floor. Provide top mounted washerless centerset lavatory faucets.

2.4.4 Plastic Shower Stalls

IAPMO Z124.1.2 four piece white solid acrylic pressure molded fiberglass reinforced plastic shower stalls. Shower stalls shall be scratch resistant, waterproof, and reinforced. Showerhead water flow rate shall not exceed 1.5 gpm when measured at a flowing water pressure of 80 psi. Provide flow restrictor in handshower to flow 1.5 gpm. Provide filters for chlorine in supply piping to showerheads. Provide recessed type shower stalls approximately 36 inches wide, 36 inches front to rear, 76 inches high, and 5 inch high curb with shower stall bottom or feet firmly

supported by a smooth level floor. Provide PVC shower floor drains and stainless steel strainers. Shower stalls shall meet performance requirements of IAPMO Z124.1.2 and shall be labeled by NAHB Research Foundation, Inc. for compliance. Install shower stall in accordance with the manufacturer's written instructions. Finish installation by covering shower stall attachment flanges with dry-wall in accordance with shower stall manufacturer's recommendation. Provide smooth 100 percent silicone rubber white bathtub calk between the top, sides, and bottom of shower stalls and bathroom walls and floors.

2.4.5 Precast Terrazzo Shower Floors

Terrazzo shall be made of marble chips cast in white portland cement to produce 3000 psi minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

2.4.6 Emergency Eyewash and Shower

ANSI/ISEA Z358.1, floor supported free standing unit. Provide deluge shower head, stay-open ball valve operated by pull rod and ring or triangular handle. Provide eyewash and stay-open ball valve operated by foot treadle or push handle.

2.5 DRAINS

2.5.1 Floor and Shower Drains

Floor and shower drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.6.3. Provide drain with trap primer connection, trap primer, and connection piping. Primer shall meet ASSE 1018.

2.5.1.1 Metallic Shower Pan Drains

Where metallic shower pan membrane is installed, polyethylene drain with corrosion-resistant screws securing the clamping device shall be provided. Drains shall have separate cast-iron "P" trap, circular body, seepage pan, and strainer, unless otherwise indicated.

2.5.1.2 Drains and Backwater Valves

Drains and backwater valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

2.5.2 Shower Faucets and Drain Fittings

Provide single control pressure equalizing shower faucets with body mounted from behind the wall with threaded connections. Provide ball joint self-cleaning shower heads. Provide shower heads which deliver a maximum of 2.2 GPM at 80 PSI per Energy Star requirements. Provide tubing mounted from behind the wall between bathtub faucets and shower heads . Provide separate globe valves or angle valves with union connections in each supply to faucet. Provide trip-lever pop-up drain fittings for above-the-floor drain installations. The top of drain pop-ups, drain outlets, tub overflow outlet, and; control handle for pop-up drain shall be chromium-plated or polished stainless steel. Linkage between drain pop-up and pop-up control handle at bathtub overflow outlet shall be copper alloy or stainless steel. Provide shower valve with ball type control handle.

2.5.3 Sight Drains

Sight drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided for other than concrete construction. Drains shall have a galvanized heavy cast-iron body and seepage pan and chromium-plated bronze, nickel-bronze, or nickel-brass strainer and funnel combination. Drains shall be provided with threaded connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular, unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the strainer. Minimum dimensions shall be as follows, unless otherwise noted:

Area of strainer and collar:	36 square inches
Height of funnel:	3-3/4 inches
Diameter of lower portion:	2 inches of funnel
Diameter of upper portion:	4 inches of funnel

2.6 TRAPS

Unless otherwise specified, traps shall be copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be with a cleanout. Provide traps with removable access panels for easy clean-out at sinks and lavatories. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for

lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.7 WATER HEATERS

Water heater types and capacities shall be as indicated. Each primary water heater shall have controls with an adjustable range that includes 90 to 160 degrees F. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified.

2.7.1 Electric Instantaneous Water Heaters (Tankless)

UL 499 and UL listed flow switch activated, tankless electric instantaneous water heater for wall mounting below sink or lavatory.

2.8 COMPRESSED AIR SYSTEM

Extension piping for existing shop compressed air system shall be as specified for instrument compressed air system. See Section 23 52 33.03 20 STEAM BOILER SYSTEM for instrument compressed air system requirements.

2.9 ELECTRICAL WORK

Provide internal wiring for components of packaged equipment as an integral part of the equipment.

For packaged equipment, the manufacturer shall provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.10 MISCELLANEOUS PIPING ITEMS

2.10.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.10.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where supply, drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.10.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.10.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.10.3 Pipe Hangers (Supports)

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A full port ball valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with

the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings..

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and full port ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining.

3.1.1.7 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

3.1.2 Compressed Air Piping (Non-Oil Free)

Compressed air piping shall be suitable for 125 psig working pressure. Compressed air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.3.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or

with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.3.2 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.3.3 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.3.4 Copper Tube and Pipe

a. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.

b. Copper Tube Extracted Joint. Mechanically extracted joints are prohibited .

c. Press connection. Copper press connections shall be made in **strict** accordance with the manufacturer's installation instructions for manufactured rated size. The joints shall be pressed using the tool(s) approved by the manufacturer **of that joint**. Minimum distance between fittings shall be in accordance with the manufacturer's requirements.

3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.5 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.5.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

Sleeves shall not be installed in structural members, except where

indicated or approved. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of one inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall be acoustically sealed for interior walls which are not designated as fire rated.

3.1.5.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated.

3.1.5.3 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

a. A standard roof coupling for threaded pipe up to 6 inches in diameter.

b. A tack-welded or banded-metal rain shield around the pipe with sealant.

3.1.5.4 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.6 Supports

3.1.6.1 General

Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not

exceed the hanger and support spacing required for any individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.6.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and Section 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT, Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROL FOR HVAC PIPING AND EQUIPMENT and as shown. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided. Material used for supports shall be as specified in Section 05 12 00 STRUCTURAL STEEL and Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.1.6.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 40 shields shall:

    1. Be used on insulated pipe less than 4 inches.

    2. Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.

    3. Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.

h. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Horizontal pipe runs shall include allowances for expansion and contraction.

i. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

j. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

3.1.6.4 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the COR. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.7 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

3.2 WATER HEATERS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

3.2.2 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 30 inches above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure. Bumpers for water closet seats shall be installed on the wall or flushometer stop or flushometer spud.

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC/ANSI A117.1.

3.3.4 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the de sited height and in proper relation to the wall.

3.3.4.1 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright.

3.3.4.2 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.3.5 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.3.6 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

3.3.7 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron.

3.4 IDENTIFICATION SYSTEMS

3.4.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.4.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.5 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.6 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.6.1 Painting of New Equipment

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.6.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.7 TESTS, FLUSHING AND DISINFECTION

3.7.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with CPC , except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure to the COR for approval.

a. Drainage and Vent Systems Test. The final test shall include a smoke test.

b. Building Sewers Tests.

c. Water Supply Systems Tests.

3.7.1.1 Compressed Air Piping (Non oil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 150 psig and hold this pressure for 2 hours with no drop in pressure.

3.7.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.7.3 System Flushing

3.7.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with hot potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the COR (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.7.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Comply with ASHRAE 90.1 - IP for minimum efficiency requirements. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 141.80 (c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.7.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, and faucet.

e. Temperature of each domestic hot-water supply.

f. Operation of each floor and roof drain by flooding with water.

g. Operation of each vacuum breaker and backflow preventer.

3.7.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator and booster pump until the entire system is completely filled.

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet shall be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

Upon the specified verification, the system including tanks shall then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet shall be opened and closed several times.

Take addition samples of water in disinfected containers, for bacterial examination, at locations specified by the COR
Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with EPA SM 9223 and AWWA 10084. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.8 WASTE MANAGEMENT

Place materials defined as hazardous or toxic waste in designated containers. Return solvent and oil soaked rags for contaminant recovery

and laundering or for proper disposal. Close and seal tightly partly used sealant and adhesive containers and store in protected, well-ventilated, fire-safe area at moderate temperature. Place used sealant and adhesive tubes and containers in areas designated for hazardous waste. Separate copper and ferrous pipe waste in accordance with the Waste Management Plan and place in designated areas for reuse.

3.9 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.10 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows: Refer to equipment schedule.

3.11 TABLES

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE			
Item #	Pipe and Fitting Materials	A	B	C	D
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark.	X	X	X	X
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A888. Pipe and fittings shall be marked with the CISPI trademark.		X	X	X
3	Copper drainage tube, (DWV), ASTM B306	X*	X	X*	X
4	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X
5	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X

SERVICE:

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE			
Item #	Pipe and Fitting Materials	A	B	C	D

A - Underground Building Soil, Waste and Storm Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent

* - Hard Temper

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE			
Item No.	Pipe and Fitting Materials	A	B	C	D
1	Malleable-iron threaded fittings, a. Galvanized, ASME B16.3 for use with Item 4a	X			
24	Steel pipe: a. Seamless, galvanized, ASTM A53/A53M, Type S, Grade B		X		
3	Seamless copper water tube, ASTM B88, ASTM B88M	X**	X**		X***
4	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 8	X	X		X
5	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 8	X	X		X
6	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83		X		
7	Nipples, pipe threaded ASTM A733		X		
8	Press Fittings	X	X		

a - Cold Water Service Aboveground
b - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground
c - Compressed Air Lubricated
d - Cold Water Service Belowground
Indicated types are minimum wall thicknesses.
** - Type L - Hard
*** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors
**** - In or under slab floors only brazed joints

-- End of Section --

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SECTION 22 31 00

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SECTION 22 31 00

WATER SOFTENERS, CATION-EXCHANGE (SODIUM CYCLE)

PART 1 GENERAL

1.1 SUMMARY

This section covers fully automatic, semi-automatic, and manual water softening equipment.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084	Standard Methods for the Examination of Water and Wastewater
AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C700	Standard for Cold Water Meters - Displacement Type, Bronze Main Case
AWWA C701	Standard for Cold-Water Meters - Turbine Type for Customer Service
AWWA D102	Coating Steel Water-Storage Tanks

ASME INTERNATIONAL (ASME)

ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B16.3	Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.39	Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300

ASME B40.100	Pressure Gauges and Gauge Attachments
ASME BPVC SEC VIII D1	BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A6/A6M	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A666	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM D 1785	Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 3299	Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks
ASTM E 100	ASTM Hydrometers
ASTM E 126	Inspection and Verification of Hydrometers
ASTM F 593	Stainless Steel Bolts, Hex Cap Screws, and Studs

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
MSS SP-70	Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-80	Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	Standard for Industrial Control and Systems: General Requirements
NEMA MG 1	Motors and Generators

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

Drawings showing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-03 Product Data

Softening Equipment

A complete list of equipment and material, including manufacturer's descriptive and technical literature; performance charts and curves; catalog cuts; and installation instructions.

Spare Parts

Spare parts data for each different item of material and equipment, as specified.

Field Instructions

Proposed diagrams, instructions, and other sheets, prior to posting. Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

SD-06 Test Reports

Softening Equipment
Piping

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon

completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions

Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operation features. Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions shall include simplified wiring, layout, and control diagrams of the system as installed.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.5 EXTRA MATERIALS

a. Submit spare parts data for each different item of material and equipment, after approval of the detail drawings and not later than 1 month prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 years of service.

b. Provide, for each type of equipment furnished, special tools necessary for adjustment, operation, maintenance, and disassembly; a grease gun or other lubricating device for each type of grease required; and one or more steel cases mounted on the wall complete with flat key locks, two keys, and clips or hooks to hold each tool in a convenient location. Tools shall be high-grade, smooth, forged, alloy, tool steel. Grease guns shall be lever type. Tools shall be delivered at the same time as the equipment and handed over on completion of the work.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

a. Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the COR, reasonably convenient to the site.

b. Pumps and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.2 SOFTENING EQUIPMENT

Softener battery shall consist of not more than 3 (i.e., 1, 2, or 3)

water-softener units. Performance specified shall refer to each unit and not to the battery as a whole. Preference is for a single unit system, if possible.

2.2.1 Equipment Capacity

Each of the units shall be a semi-automatic downflow pressure-type water softener, having a capacity to soften 362,388/n gallons of water with a maximum influent total hardness of 110 milligrams per liter (mg/L) during the interval between successive regenerations, to a maximum effluent total hardness of 0.2 mg/L. Intervals between successive generations shall be 1 week.

Each unit shall have the capacity to handle a peak rate of 25,468/n gph. All units are in service at the same time.3 Typical water properties are as follows:

Component	Concentration mg/L	Component	Concentration mg/L
Total Solids	Unknown	Alkalinity	Unknown
Total Dissolved Solids	39-203	Methyl Orange as Calcium Carbonate	Unknown
Calcium	3-26	Phenolphthalein as Calcium Carbonate	Unknown
Sodium and Potassium	3-29	Total Hardness as Calcium Carbonate	110 (14-100)
Total Iron	Unknown	Carbonate Hardness as Calcium Carbonate	Unknown
Ferric Iron	Unknown	Noncarbonate Hardness as Calcium Carbonate	Unknown
Ferrous Iron	Unknown	Free Carbon Dioxide Calcium Carbonate	Unknown
Manganese	Unknown	Turbidity in Nethlometric Turbidity units	0.06-0.3
Copper	Unknown	Color by Platinum Standard Comparison	Unknown
Silica	5-7.7	Residual Chlorine	0.02-2.15
Sulphate	1-34.9	Dissolved Oxygen	Unknown
Chlorides	4-15	Conductivity pH	8.5-9.2

Component	Concen-tration mg/L	Component	Concen-tration mg/L
Nitrates	Unknown		

2.2.2 Softener Tank

Softener tank shall be a minimum of 48 inches in diameter by TBD inches straight shell (tangent line to tangent line). Tank shall be of buttwelded steel construction conforming to the ASME BPVC SEC VIII D1. Shell shall be designed for a working pressure of 100 psi. Tank shall be lined with nontoxic epoxy or rubber conforming to AWWA D102. The upper head of each tank shall be provided with an access opening 11 inches by 15 inches or larger. Lower side shell of each tank shall be provided with an access opening 4 by 6 inches or larger. Tank shall have angle leg orskid supports of cast-iron or steel.

2.2.3 Underdrain System

A system shall be provided within the softener tank for collecting softened water and distributing backwash water. The system shall be header-lateral-distributor head type. Underdrain system shall distribute the backwash water uniformly over the entire filter area, and at such velocities that will prevent the channeling of the filter bed.

2.2.3.1 Header-Lateral-Distributor Head Type

Header-lateral-distributor head type shall consist of a central manifold or header, connected to laterals provided with strainer heads or strainers with openings placed radially so as to discharge horizontally or downward. System shall be supported by a steel plate or steel angles conforming to ASTM A666 with rubber or nontoxic epoxy linings. Where the system will permit the loss of the exchange material during the filtering cycle, the system shall be provided with a gravel bed. All bolts and attaching hardware shall be stainless steel, conforming with ASTM F 593. Headers and laterals shall be polyvinyl chloride, conforming to ASTM D 1785 or ASTM D 2241. Strainer heads and strainers shall be manufactured of materials compatible with the header-lateral system, and shall be brass or stainless steel. Laterals and strainer heads, after being placed, shall not protrude into the header or laterals.

2.2.4 Gravel Bed

Supporting bed shall be placed above the underdrain systems. Gravel shall be free from clay, loam, dirt, and calcareous or other foreign materials and shall be free of flat or elongated particles. Gravel bed shall be properly graduated to distribute the backwash water, to prevent loss of exchange materials, and to prevent migration of the material in the gravel bed during operation and backwashing. Gravel bed shall not be less than 9 inches in depth. Where the void size of the top layer of gravel is greater than the smallest particle size of the exchange material, a 3 inch layer of ilmenite or garnet sand shall be added to the gravel bed.

2.2.5 Exchange Material

Exchange material shall be of styrene-resinous type, washed, processed, graded, and suitable for water softening purposes. All granules shall be clean and hard, and the material shall be free from defects that affect the

serviceability and appearance of the finished product. Exchange material shall not require dosing or the adding of any chemical mixture or solution to the water to be or to the water used for backwashing or regeneration other than sodium chloride, except for a cleaner additive recommended by the Exchange Material Manufacturer. Material shall conform to the following:

a. Working exchange capacity not less than 30,000 grains pcf.

b. Approximate shipping weight of 50-55 pcf, backwashed and drained volume.

c. Effective size not less than 0.45 millimeters.

d. Uniformity coefficient not greater than 2.0.

e. Not more than 1 percent by weight to pass 50-mesh US standard screen.

Bed depth shall not be less than 30 inches. Application rate shall not exceed 2 gpm per cubic foot of exchange material. Minimum freeboard above exchanger bed shall be not less than 50 percent of bed depth.

2.3 BRINE APPLICATION SYSTEM

A brine application system, comprising one tank, shall be provided for each installation. Single tank units shall serve as a combined salt saturator and brine tank. Minimum capacity of the system shall be such as to provide sufficient salt storage for the weekly regeneration cycles or 24-hour operation, whichever is greater.

2.3.1 Tanks

Each saturator, brine or combined-purpose tank shall be fabricated from steel conforming to ASTM A6/A6M not less than 3/16 inch thick, lined with enamel, or of fiber glass filament-wound reinforced plastic construction, conforming to ASTM D 3299. Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS. Each tank shall be equipped with an underdrain system manufactured from polyvinyl chloride conforming to ASTM D 1785 or ASTM D 2241 and provided with a layer of graded gravel or screens for filtering the brine. Screens shall be manufactured from polyvinyl chloride, or stainless steel. Saturator tank or combined-purpose tank shall be equipped with a water inlet valve float-operated. Water inlet valves and switches shall be mounted externally. Floats and probes may be mounted internally or externally, in such a manner that the stored salt shall not interfere with their operation. All devices in contact with or subject to splashing of brine solution shall be fabricated from polyvinyl chloride.

2.3.2 Hydraulic System

A hydraulic ejector of all bronze construction with valves, piping, and connections shall be provided for lifting brine from the brine or combined tank. Ejector shall have sufficient capacity to permit a 2 to 1 variation in the concentrated brine rate of flow. Hydraulic ejector system shall be equipped with a manual rate-set valve and a check valve on the suction side of the ejector. Where the brine tank or combination tank is emptied during each regeneration period, the suction side of the ejector system shall be provided with a device to prevent the entrance of air into the system. Hydraulic ejector system shall be capable of automatically flushing out the dilute brine piping system or completion of the brine cycle. The dilution

water supply shall be protected from inflow of brine by means of back flow prevention device.

2.4 CONTROLS

2.4.1 Valves

Transfer of water and brine solution to and from the water softener shall be accomplished by a single-unit multiple-port valve or by a package-type valve nest for semiautomatic operation. Design of the valve mechanisms shall be such that gradually increasing flows will be attained as ports are opened and initial surges and sudden inrushes of water or brine are avoided. A dial pointer shall indicate each step of the operation.

2.4.1.1 Multiple-Port Valve

Multiple-port valve shall consist of an assembly of nonsticking, nonleaking, water-lubricated valve ports that connect to the hard-water inlet, soft-water outlet, backwash inlet and outlet, and brine inlet, all enclosed in a single casing. Design shall permit the various steps of operation service, backwash, brine flow, and rinse to be accomplished by the rotation of a shaft that drives the mechanism causing the opening and closing of ports in correct sequence.

2.4.1.2 Package-Type Valve

Package-type valve nest shall consist of a pilot valve connected with fittings as may be required to each one of a nest of valves hydraulically or pneumatically operated. Nest of valves shall have connections to hard-water inlet, soft-water outlet, backwash inlet and outlet, and brine inlet.

2.4.2 Operation

Control of softener regeneration shall be semiautomatic initiated manually by a pushbutton in response to an alarm with switch connected to an automatic hardness tester. Use of semiautomatic controls shall permit regeneration to proceed automatically with no manual assistance other than replenishment of salt storage. Controls shall be subject to convenient and accurate manual adjustment and shall be designed for manual operation in the event of failure of the electrical equipment. An interlocking system shall be provided to prevent regeneration of more than one unit at a time.

2.5 ELECTRICAL WORK

ON SYSTEM. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices, shall be provided.

2.6 BOLTS, NUTS, AND FASTENERS

All bolts, anchor bolts, nuts, washers, plates, bolt sleeves, and all other types of supports necessary for the installation of the equipment shall be furnished with the equipment and shall be galvanized unless otherwise indicated. Expansion bolts shall have malleable-iron and lead composition elements. Unless otherwise specified, stud, tap, and machine bolts shall be of refined bar iron. All threads shall conform to ASME B1.1. Bolts, anchor bolts, nuts, and washers specified to be galvanized, shall be zinc coated, after being threaded, by the hot-dip process in conformity with

ASTM A123/A123M or ASTM A153/A153M. Bolts, anchor bolts, nuts, and washers specified to be stainless steel shall be Type 316 stainless steel. Where indicated, specified, or required, anchor bolts shall be provided with square plates at least 4 by 4 by 3/8 inch or shall have square heads and washers and be set in the concrete forms with suitable pipe sleeves.

2.7 AUXILIARY EQUIPMENT

2.7.1 Water Meter

Each softener shall be provided with a displacement or turbine-type water meter reading in U.S. gallons, and shall conform to AWWA C700 or AWWA C701 as appropriate. Meter shall be equipped with necessary wiring and an alarm device to give notice when the unit has delivered 362,388/n gallons of water. Meter shall be installed in the soft-water line from the softener unit, and shall be so located as to be readily accessible for reading and setting. Meter contacts shall be infinitely adjustable over the range of the meter to permit setting to suit actual hardness of the water being treated. The purpose of the alarm is to notify that the capacity of the unit is being approached.

2.7.2 Automatic Hardness Tester

A hardness tester for automatically testing the hardness of the water shall be installed in the soft-water line leading from each softener unit. Automatic hardness tester shall be wall mounted and shall be capable of carrying out intermittent tests on the softened water and of giving visual warning that the residual hardness present exceeds a predetermined limit. Tester shall be equipped with necessary wiring and an alarm device to give notice when the hardness of the water delivered by the softener unit exceeds 0.2 mg/1.

2.7.3 Electric Motors

Motors shall be single-phase, suitable for operation on 115-volt, single-phase, 60 cycle, alternating current conforming to NEMA MG 1. Each motor shall be designed for operation in a 40-degree C ambient temperature. Motor controls shall conform to NEMA ICS 1.

2.7.4 Piping

Pipe smaller than 4 inches in diameter, excluding the underdrain and brine collection systems, shall be fabricated from galvanized steel conforming to ASTM A53/A53M with malleable-iron fittings conforming to ASME B16.3. Pipe 4 inches in diameter and larger shall be flanged ductile-iron conforming to AWWA C115/A21.15 with ductile-iron fittings conforming to AWWA C110/A21.10 and AWWA C111/A21.11. Pipe hangers and supports conforming to MSS SP-58 and MSS SP-69 shall be used on all 1-1/2 inch diameter or smaller pipe with runs longer than 7 feet, and on all 2 inch diameter or larger pipe with runs longer than 9 feet. The pipe hanger and supports shall be fabricated from steel and shall be spaced not more than 7 to 9 feet as applicable.

2.7.5 Valves and Unions

Gate valves smaller than 4 inches shall be bronze with screwed ends, conforming to MSS SP-80 and valves 4 inches or larger shall be iron body with flanged ends, conforming to MSS SP-70. Valves shall open counterclockwise, and the operating wheel shall have an arrow, cast in the metal, indicating the direction of opening. Unions shall conform to

ASME B16.39.

2.7.6 Gauges and Cocks

Pressure gauges and sampling cocks shall be furnished on each softener unit connected to the hard-water inlet and soft-water outlet to indicate the pressure loss through the softener and its pipe, valve, and fitting assembly, and to sample the hard and soft water. A sampling cock shall also be provided on the brine system which will permit sampling of the dilute brine solution. Gauges shall be precision type with bronze Bourdon tube and phenolic case and an accuracy of plus or minus 1/2 percent conforming to ASME B40.100. Sampling cocks shall be of brass, ground key, lever handle, faucet type.

2.7.7 Water and Brine Testing Equipment

A complete water-testing set recommended by the manufacturer shall be provided with the softener. The set shall include complete instructions for conducting tests for hardness in accordance with AWWA 10084. Two Baume hydrometers conforming to ASTM E 100 and ASTM E 126, and calibrated for the range necessary for testing saturated brine solution and three glass cylinders of heat-resistant glass to hold sufficient brine for testing shall also be provided.

2.8 FACTORY PAINTING

Factory painting shall conform to manufacturer's standard factory finish for the intended service.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the COR of any discrepancy before performing the work.

3.2 INSTALLATION

3.2.1 Softener and Brine Tanks

Softener and brine tanks shall be anchored to a concrete mat. Anchor brackets, anchor rods or straps shall be provided to hold the tank to the anchors in the mat.

3.2.2 Valves

Install valves as nearly as possible in the position indicated consistent with convenience of operating the hand wheel. Carefully erect and support all valves in their respective position free from all distortion and strain on appurtenances during handling and installation. All material shall be carefully inspected for defects in workmanship and material, and debris and foreign material cleaned out of valve openings and seats, all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced.

3.2.3 Pumps

Pump and motor shall be mounted on a common monoblock. The monoblock shall be anchored to a concrete mat. Anchor brackets, anchor rods, or straps shall be provided to hold the monoblock to the anchors in the mat.

3.2.4 Piping

Install piping to accurate lines and grades and, where possible, parallel to building walls. Where temporary supports are used, they shall be sufficiently rigid to prevent shifting or distortion of the pipe. Provision shall be made for expansion where necessary. All piping shall pitch toward low points, and provision shall be made for draining these low points. A sufficient number of unions or flanges shall be used to allow for the dismantling of all water pipe, valves, and equipment. Installation of piping including cleaning, cutting, threading and jointing, shall be in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.3 MANUFACTURER'S SERVICES

3.3.1 Manufacturer's Representative

Provide services by a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified. Representative shall supervise the installing, adjusting, and testing of equipment.

3.3.2 Field Training

Conduct training course for operating staff as designated by the COR. The training period, for a total of 20 hours of normal working time, shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the Operating and Maintenance Instructions.

3.4 TESTING AND PERFORMANCE

After installation of the water softener, operating tests shall be carried out to assure that the water softener system operates properly. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests reconducted.

3.4.1 Softeners

Run each softener to exhaustion and regenerate it to full capacity in accordance with manufacturer's instructions before test is started. Softener shall be put through a complete cycle of operation at a constant flow rate of approximately 424/n gpm for capacity test. During capacity test, the softened water shall be wasted to the sewer if necessary to maintain the required flow rate. Total grains of equivalent calcium carbonate removed shall be determined by test of the hard water at such intervals as will give a representative calcium carbonate content.

a. After each run, the unit shall be regenerated using salt brine delivered from the measuring tank in the amount called for by operating instructions. Near the end of the brine rinse and beginning of production of zero soft-water, samples of the water shall be taken every 2.5 minutes, the meter read, and the reading recorded. Samples shall be titrated for chlorides, and zero soft-water production shall

be considered to begin when chlorides, as chloride radicals, are not in excess of 20 milligrams per liter above the chloride content of the hard-water. When the required number of gallons of hard water of specified hardness have been run through the softener, a quart sample shall be taken of the softened water and tested.

b. Results of the test shall be used in determining the capacity and performance of the softener. A sample of hard-water shall be taken and tested in a similar manner. A complete log of each test run shall be made, giving the following data: date, time or readings, total water softened, and pounds of salt used per regeneration. All samples shall be collected in clean, glass-stoppered bottles. Bottles shall be thoroughly rinsed with water being sampled, and all samples shall be plainly marked for identification.

c. Supply the salt required for regeneration of the exchange material after each of the above test runs. Under actual operating conditions the exchange material shall not be washed out of the apparatus, the turbidity and color of the soft water shall not exceed the turbidity and color of the hard water, and during any softening run, slugs of dirty or turbid water shall not be delivered regardless of the change of demand rate up to the maximum on the apparatus. During the specified test of the softener, the soft-water sampling cock shall remain open and a stream of softened water shall be run through a rubber hose, discharging at the bottom of a wide mouth, 1 gallon glass jar or bottle set against a white background so that the color and turbidity may be under observation at all times. Amount of salt used for regeneration shall not exceed 1/2 pound per 1,000 grains hardness of equivalent calcium carbonate removed.

3.4.2 Piping

After installation, test all pipelines for watertightness. For these tests furnish testing plugs or caps, all necessary pressure pumps, pipe connections, gauges, other equipment, and all labor required. Test pressures shall be indicated in the process pipe schedule shown. Test of joints of air lines shall be made using a soapy water solution to detect leaks. The obtaining of water, electric power and other utility items as well as the disposal of water drainage are also the responsibilities of Contractor.

3.5 FIELD PAINTING

Equipment which did not receive a factory finish shall be painted as specified in Section 09 90 00 PAINTS AND COATINGS. Factory painted items requiring touching up in the field shall be thoroughly cleaned of all foreign material and shall be primed and top-coated with the manufacturer's standard factory finish.

-- End of Section --

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SECTION 23 00 00

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

This section covers air supply, distribution, ventilation, and exhaust portions of an HVAC system.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-D	Laboratory Methods of Testing Dampers for Rating

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 62.1	Ventilation for Acceptable Indoor Air Quality
ASHRAE 70	Method of Testing for Rating the Performance of Air Outlets and Inlets

ASME INTERNATIONAL (ASME)

ASME A13.1	Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A924/A924M	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B117	Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM C 1071	Standard Specification for Fibrous Glass

	Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM C 916	Standard Specification for Adhesives for Duct Thermal Insulation
ASTM D 1654	Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 3359	Measuring Adhesion by Tape Test
ASTM D 520	Zinc Dust Pigment
ASTM E 2016	Standard Specification for Industrial Woven Wire Cloth
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701	Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1966	HVAC Duct Construction Standards Metal and Flexible, 3rd Edition

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	Color Code for Pipelines & for Compressed Gas Cylinders

UNDERWRITERS LABORATORIES (UL)

UL 181	Factory-Made Air Ducts and Air Connectors
UL 723	Test for Surface Burning Characteristics of Building Materials
UL Bld Mat Dir	Building Materials Directory

1.3 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.3.1 Mechanical Equipment Identification

1.3.1.1 Diagrams

Submit proposed diagrams, at least 2 weeks prior to start of related testing. Provide neat mechanical drawings provided with extruded aluminum frame under 1/8-inch glass or laminated plastic, system diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system. After approval, post these items where directed.

1.3.2 Service Labeling

Label equipment, including fans, air handlers, etc. with labels made of self-sticking, plastic film designed for permanent installation. Labels shall be in accordance with tag in schedule

Identify similar services with different temperatures or pressures. Label and arrow HVAC piping in accordance with the following:

a. Each point of entry and exit of pipe passing through walls.

b. Each change in direction, i.e., elbows, tees.

c. In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.

d. In long straight runs, locate labels at distances within eyesight of each other not to exceed 75 feet. All labels shall be visible and legible from the primary service and operating area.

For Bare or Insulated Pipes	
for Outside Diameters of	Lettering
1/2 thru 1-3/8 inch	1/2 inch
1-1/2 thru 2-3/8 inch	3/4 inch
2-1/2 inch and larger	1-1/4 inch

1.3.3 Color Coding

Color coding of all piping systems shall be in accordance with ASME A13.1 and MIL-STD-101.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Insulated Nonmetallic Flexible Duct Runouts
Duct Connectors
Duct Access Doors

Manual Balancing Dampers

Sound Attenuation Equipment
Acoustical Duct Liner
Diffusers
Registers and Grilles

Rooftop Air Conditioning Unit

Test Procedures

SD-06 Test Reports

Performance Tests

SD-07 Certificates

Certification

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions
Operation and Maintenance Training

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

Manual Balancing Dampers

Rooftop Air Conditioning units

1.5 QUALITY ASSURANCE

1.5.1 Detail Drawings

Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

Submit function designation of the equipment and any other requirements specified throughout this Section with the shop drawings.

1.5.2 Test Procedures

Submit proposed test procedures and test schedules for the ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

1.5.3 Sustainable Design Certification

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Provide equipment items that are supported by a service organization. Where applicable, provide equipment that is an ENERGY STAR Qualified product or a Federal Energy Management Program (FEMP) designated product.

2.2 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Identification plates shall be three layers, black-white-black, engraved to show white letters on black background. Letters shall be upper case. Identification plates shall be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger shall have beveled edges. Install identification plates using a compatible adhesive.

2.3 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact

by personnel or where it creates a potential fire hazard.

2.4 SEISMIC ANCHORAGE

Anchor equipment in accordance with applicable seismic criteria for the area and as defined in 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT

2.5 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouch only if approved. Otherwise, return equipment to the factory for refinishing.

2.6 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.7 DUCT SYSTEMS

2.7.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this specification.

a. Ductwork shall be constructed meeting the requirements for the duct system static pressure of 2" WG.

b. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, square elbows with factory fabricated turning vanes are allowed.

c. Provide ductwork that meets the requirements of Seal Class as noted in schedule.

d. Provide sealants that are suitable for the range of air distribution and ambient temperatures to which it is exposed. Do not use pressure sensitive tape as a sealant.

e. Make spiral lock seam duct, and flat oval with duct sealant and lock with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA 1966. Apply the sealant to the exposed male part of the fitting collar so that the sealer is on the inside of the joint and fully protected by the metal of the duct fitting. Apply one brush coat of the sealant over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar are not acceptable.

2.7.1.1 Flexible Duct

a. Provide duct that conforms to UL 181 and NFPA 90A with factory-applied insulation, vapor barrier, and end connections. Provide duct assembly that does not exceed 25 for flame spread and 50 for smoke developed. Provide ducts designed for working pressures of two inches water gauge positive and 1.5 inches water gauge negative. Provide flexible round duct length that does not exceed five feet. Secure connections by applying adhesive for two inches over rigid duct, apply flexible duct

two inches over rigid duct, apply metal clamp, and provide minimum of three No. 8 sheet metal screws through clamp and rigid duct.

b. Inner duct core: Provide interlocking spiral or helically corrugated flexible core constructed of zinc-coated steel, aluminum, or stainless steel; or constructed of inner liner of continuous galvanized spring steel wire helix fused to continuous, fire-retardant, flexible vapor barrier film, inner duct core.

c. Insulation: Provide inner duct core that is insulated with mineral fiber blanket type flexible insulation, minimum of one inch thick. Provide insulation covered on exterior with manufacturer's standard fire retardant vapor barrier jacket for flexible round duct.

2.7.1.2 General Service Duct Connectors

Provide a flexible duct connector approximately 6 inches in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a composite connector system that complies with NFPA 701 and is classified as "flame-retarded fabrics" in UL Bld Mat Dir.

2.7.2 Duct Access Doors

Provide hinged access doors conforming to SMACNA 1966 in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, thermostats, and other apparatus requiring service and inspection in the duct system. Provide access doors upstream and downstream of air flow measuring primaries . Provide doors that are a minimum 15 by 18 inches, unless otherwise shown. Where duct size does not accommodate this size door, make the doors as large as practicable. Equip doors 24 by 24 inches or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

2.7.3 Manual Balancing Dampers

Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators. Install dampers that are 2 gauges heavier than the duct in which installed. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.7.4 Manual Balancing Dampers

2.7.4.1 Round Dampers

a. Frames:

4 to 20 inches size: Minimum of 20 gauge galvanized steel, minimum of 10 inches long.b. Blades:

4 to 20 inches size: Minimum of 20 gauge galvanized steel

b. Blade Axles

To support the blades of round dampers, provide galvanized steel shafts supporting the blade the entire duct diameter frame-to-frame. Axle shafts shall extend through standoff bracket and hand quadrant.

4 to 20 inches size: Minimum of 3/8 inch square shaft.

c. Axle Bearings:

Support the shaft on each end at the frames with shaft bearings constructed of oil-impregnated bronze, or solid nylon, or a solid plastic equivalent to nylon. Shaft bearings configuration shall be a pressed fit to provide a tight joint between blade shaft and damper frame.

d. Control Shaft/Hand Quadrant:

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

e. Finish: Mill Galvanized

2.7.5 Air Supply And Exhaust Air Dampers

Where outdoor air supply and exhaust air dampers are required they shall have a maximum leakage rate when tested in accordance with AMCA 500-D as required by ASHRAE 90.1 - IP.

Maximum damper leakage at 1.0 inch w.g. for motorized dampers is 4 cfm per square foot of damper area, and non-motorized dampers are not allowed.

2.7.6 Plenums and Casings for Field-Fabricated Units

2.7.6.1 Duct Liner

Unless otherwise specified, duct liner is not permitted.

2.7.7 Sound Attenuation Equipment

a. For system with total pressure of 4 Inch Water Gauge and Lower: Use sound attenuators only where indicated. Provide factory fabricated sound attenuators that are constructed of galvanized steel sheets. Provide attenuator with outer casing that is not less than 22 gauge. Provide fibrous glass acoustical fill. Provide net sound reduction indicated. Obtain values on a test unit not less than 24 by 24 inches outside dimensions made by a certified nationally recognized independent acoustical laboratory. Provide air flow capacity as indicated or required. Provide pressure drop through the attenuator that does not exceed the value indicated. Acoustically test attenuators with metal duct inlet and outlet sections while under the rated air flow conditions. Include with the noise reduction data the effects of flanking paths and vibration transmission. Construct sound

attenuators to be airtight when operating at the internal static pressure indicated or specified for the duct system, but in no case less than 2 inch water gauge.

b. For acoustical duct liner: Use flexible elastomeric duct liner for lining ductwork and conforming to the requirements of ASTM C 1071, Type I and II. Provide uniform density, graduated density, or dual density liner composition, as standard with the manufacturer. Provide not less than 1 inch thick coated lining. Where acoustical duct liner is used, provide the thermal equivalent of the insulation specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS for liner . Increase duct sizes shown to compensate for the thickness of the lining used. In lieu of sheet metal duct with field-applied acoustical lining, provide acoustically equivalent lengths of factory fabricated double-walled internally insulated duct with perforated liner.

2.7.8 Diffusers, Registers, and Grilles

Provide factory-fabricated units of steel or aluminum that distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Provide outlets for diffusion, spread, throw, and noise level as required for specified performance. Certify performance according to ASHRAE 70. Provide sound rated and certified inlets and outlets according to ASHRAE 70. Provide sound power level as indicated. Provide diffusers and registers with volume damper with accessible operator, unless otherwise indicated. Provide opposed blade type volume dampers for all diffusers and registers. Where the inlet and outlet openings are located less than 7 feet above the floor, protect them by a grille or screen according to NFPA 90A.

2.7.8.1 Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Provide diffusers with air deflectors of the type indicated. Install ceiling mounted units with rims tight against ceiling. Provide sponge rubber gaskets between ceiling and surface mounted diffusers for air leakage control. Provide suitable trim for flush mounted diffusers. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller.

2.7.8.2 Perforated Plate Diffusers

Provide adjustable four-way air pattern controls as indicated. Provide diffuser faceplates that do not sag or deflect when operating under design conditions.

2.7.8.3 Registers and Grilles

Provide return registers that are similar in appearance to the supply register face. Furnish registers with sponge-rubber gasket between flanges and ceiling. Provide grilles as specified for registers, without volume control damper.

2.7.9 Bird Screens and Frames

Provide bird screens that conform to ASTM E 2016, No. 2 mesh, aluminum or stainless steel. Provide "medium-light" rated aluminum screens. Provide

"light" rated stainless steel screens. Provide removable type frames fabricated from either stainless steel or extruded aluminum.

2.8 AIR SYSTEMS EQUIPMENT

2.8.1 Fans

2.8.1.1 Centrifugal Type Power Roof Ventilators

Provide direct driven centrifugal type fans with backward inclined, non-overloading wheel. Provide hinged or removable and weatherproof motor compartment housing, constructed of heavy gauge aluminum. Provide fans with birdscreen, disconnect switch, gravity dampers, sound curb, roof curb, . Provide dripproof type motor enclosure. Use only lubricated bearings.

2.9 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A123/A123M or ASTM A924/A924M. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B117, ASTM D 1654, and ASTM D 3359. Submit evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors. Provide rating of failure at the scribe mark that is not less than 6, average creepage not greater than 1/8 inch. Provide rating of the inscribed area that is not less than 10, no failure. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to ASTM D 520 Type I.

Factory painting that has been damaged prior to acceptance by the COR shall be field painted in compliance with the requirements of paragraph FIELD PAINTING OF MECHANICAL EQUIPMENT.

2.10 SUPPLEMENTAL COMPONENTS/SERVICES

2.10.1 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE except as modified herein.

2.10.2 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.10.3 Controls

The requirements for controls are specified in Section 23 09 33.00 40 ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions

in the field, and advise the COR of any discrepancy before performing the work.

3.2 INSTALLATION

a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.

b. No installation is permitted to block or otherwise impede access to any existing machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors that clears a minimum of 3 feet. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333 (Electrical-Safety Related work practices).

c. Except as otherwise indicated, install emergency switches and alarms in conspicuous locations. Mount all indicators, to include gauges, meters, and alarms in order to be easily visible by people in the area.

3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain from all units . Provide a depth of each seal of 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Provide pipe cap or plug cleanouts where indicated. Connect drains indicated to connect to the sanitary waste system using an indirect waste fitting. Insulate air conditioner drain lines as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2.2 Equipment and Installation

Provide roof framing for rooftop air conditioning unit, and other similar items . Anchor and fasten as detailed.

3.2.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced. Provide access panels as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.2.4 Flexible Duct

Install pre-insulated flexible duct in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.

3.2.5 Metal Ductwork

Install according to SMACNA 1966 unless otherwise indicated. Install duct supports for sheet metal ductwork according to SMACNA 1966, unless

otherwise specified. Do not use friction beam clamps indicated in SMACNA 1966. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips.

3.2.6 Acoustical Duct Lining

Apply lining in cut-to-size pieces attached to the interior of the duct with nonflammable fire resistant adhesive conforming to ASTM C 916, Type I, NFPA 90A, UL 723, and ASTM E 84. Provide top and bottom pieces that lap the side pieces and are secured with welded pins, adhered clips of metal, nylon, or high impact plastic, and speed washers or welding cup-head pins installed according to SMACNA 1966. Provide welded pins, cup-head pins, or adhered clips that do not distort the duct, burn through, nor mar the finish or the surface of the duct. Make pins and washers flush with the surfaces of the duct liner and seal all breaks and punctures of the duct liner coating with the nonflammable, fire resistant adhesive. Coat exposed edges of the liner at the duct ends and at other joints where the lining is subject to erosion with a heavy brush coat of the nonflammable, fire resistant adhesive, to prevent delamination of glass fibers. Apply duct liner to flat sheet metal prior to forming duct through the sheet metal brake. Additionally secure lining at the top and bottom surfaces of the duct by welded pins or adhered clips as specified for cut-to-size pieces. Other methods indicated in SMACNA 1966 to obtain proper installation of duct liners in sheet metal ducts, including adhesives and fasteners, are acceptable.

3.2.7 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, perform temporary dust control protection. Protect the distribution system (supply and return) with temporary seal-offs at all inlets and outlets at the end of each day's work. Keep temporary protection in place until system is ready for startup.

3.2.8 Insulation

Provide thickness and application of insulation materials for ductwork, piping, and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2.9 Duct Test Holes

Provide holes with closures or threaded holes with plugs in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Plug insulated duct at the duct surface, patched over with insulation and then marked to indicate location of test hole if needed for future use.

3.2.10 Power Transmission Components Adjustment

Test V-belts and sheaves for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Uniformly load belts on drive side to prevent bouncing. Make alignment of direct driven couplings to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.3 CUTTING AND PATCHING

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed locations, in or through existing floors, by drilling and smooth by sanding. Use of a jackhammer is permitted only where specifically approved. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.

3.4 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. When the work area is in an occupied space, protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

3.5 FIELD PAINTING OF MECHANICAL EQUIPMENT

3.5.1 Finish Painting

The requirements for finish painting of items only primed at the factory, and surfaces not specifically noted otherwise, are specified in Section 09 90 00 PAINTS AND COATINGS.

3.5.2 Color Coding Scheme for Locating Hidden Utility Components

Use scheme in buildings having suspended grid ceilings. Provide color coding scheme that identifies points of access for maintenance and operation of components and equipment that are not visible from the finished space and are accessible from the ceiling grid, consisting of a color code board and colored metal disks. Make each colored metal disk approximately 3/8 inch diameter and secure to removable ceiling panels with fasteners. Insert each fastener into the ceiling panel so as to be concealed from view. Provide fasteners that are manually removable without the use of tools and that do not separate from the ceiling panels when the panels are dropped from ceiling height. Make installation of colored metal disks follow completion of the finished surface on which the disks are to be fastened. Provide color code board that is approximately 3 foot wide, 30 inches high, and 1/2 inches thick. Make the board of wood fiberboard and frame under glass or 1/16 inch transparent plastic cover. Make the color code symbols approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. Mount the color code board where indicated in the mechanical or equipment room. Make the color code system as indicated below:

3.6 IDENTIFICATION SYSTEMS

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Provide tags that are 1-3/8 inch minimum diameter with stamped or engraved markings. Make indentations black for reading clarity. Attach tags to valves with No. 12 AWG 0.0808-inch diameter

corrosion-resistant steel wire, copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.7 DUCTWORK LEAK TEST

Perform ductwork leak test as noted on schedule.

3.8 TESTING, ADJUSTING, AND BALANCING

The requirements for testing, adjusting, and balancing are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC. Begin testing, adjusting, and balancing only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.9 PERFORMANCE TESTS

After testing, adjusting, and balancing is complete as specified, test each system as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Record the testing during the applicable season. Make corrections and adjustments as necessary to produce the conditions indicated or specified. Conduct capacity tests and general operating tests by an experienced engineer. Provide tests that cover a period of not less than 7 days for each system and demonstrate that the entire system is functioning according to the specifications. Make coincidental chart recordings at points indicated on the drawings for the duration of the time period and record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient temperature and humidity in a shaded and weather protected area.

Submit test reports for the ductwork leak test, and performance tests in booklet form, upon completion of testing. Document phases of tests performed including initial test summary, repairs/adjustments made, and final test results in the reports.

3.10 CLEANING AND ADJUSTING

Provide a temporary bypass for water coils to prevent flushing water from passing through coils. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and install new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions. Maintain all equipment installed under the contract until close out documentation is received, the project is completed and the building has been documented as beneficially occupied.

3.11 OPERATION AND MAINTENANCE

3.11.1 Operation and Maintenance Manuals

Submit sixmanuals at least 2 weeks prior to field training. Submit data complying with the requirements specified in Section 01 78 23 OPERATION AND

MAINTENANCE DATA. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data

3.11.2 Operation And Maintenance Training

Conduct a training course for the members of the operating staff as designated by the COR. Make the training period consist of a total of 8 hours of normal working time and start it after all work specified herein is functionally completed and the Performance Tests have been approved. Conduct field instruction that covers all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations. Submit the proposed On-site Training schedule concurrently with the Operation and Maintenance Manuals and at least 14 days prior to conducting the training course.

-- End of Section --

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SECTION 23 03 00.00 20

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

This section covers the mechanical general requirements for all sections of Divisions: 21, FIRE SUPPRESSION; 22, PLUMBING; and 23 HEATING< VENTILATING AND AIR CONDITIONING.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM B117	Standing Practice for Operating Salt Spray (Fog) Apparatus

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	Motors and Generators
NEMA MG 10	Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems

(SCS)Indoor Advantage

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Certification

1.4 RELATED REQUIREMENTS

This section applies to all sections of 22, PLUMBING; and 23, HEATING, VENTILATING, AND AIR CONDITIONING of this project specification, unless specified otherwise in the individual section.

1.5 QUALITY ASSURANCE

1.5.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.5.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.5.3 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.5.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.5.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of

similar meaning, to mean the COR.

1.5.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "COR." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.5.5.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the COR as authorized by his administrative cognizance and the FAR.

1.5.5.3 Sustainable Design Certification

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.6 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the COR. Replace damaged or defective items.

1.7 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.7.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters (except starters/controllers which are indicated as part of a motor control center), control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided under Division 26, except internal wiring for components of package equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work.

1.7.2 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 26.

1.7.3 High Efficiency Motors

1.7.3.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.7.3.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

1.7.4 Three-Phase Motor Protection

Provide controllers for motors rated one 1 horsepower and larger with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.9 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of 1 mil; and two coats of enamel applied to a minimum dry film thickness of 1 mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

-- End of Section --

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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 23 05 48.00 40

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SECTION 23 05 48.00 40

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

This section covers vibration-isolation systems for air-conditioning equipment.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S2.40	Mechanical Vibration of Rotating and Reciprocating Machinery - Requirements for Instruments for Measuring Vibration Severity
ASA S2.71	Guide to the Evaluation of Human Exposure to Vibration in Buildings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE HVAC APP IP HDBK	HVAC Applications Handbook, I-P Edition

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB PROCEDURAL STANDARDS	Procedural Standards for TAB (Testing, Adjusting and Balancing) Environmental Systems

1.3 GENERAL REQUIREMENTS

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section to the extent applicable.

All vibration-control apparatus must be the product of a single manufacturing source, where possible. Human exposure levels should be considered using ASA S2.71 and NEBB PROCEDURAL STANDARDS.

Scheduled isolation mounting is in inches and is a minimum static deflection.

Spans referred to in Part 2, "Vibration-Isolation Systems Application," must mean longest bay dimension.

Determine exact mounting sizes and number of isolators by the isolator manufacturer based on equipment that will be installed. Check equipment revolutions per minute (rpm) and spring deflections to verify that resonance cannot occur.

Five working days prior to commencement of installation, submit installation drawings for vibration isolator systems including equipment and performance requirements.

Indicate within outline drawings for vibration isolator systems, overall physical features, dimensions, ratings, service requirements, and weights of equipment.

Within ten working days of Contract Award, submit equipment and performance data for vibration isolator systems including equipment base design; inertia-block mass relative to support equipment weight; spring loads and free, operating, and solid heights of spring; spring diameters; nonmetallic isolator loading and deflection; disturbing frequency; natural frequency of mounts; deflection of working member; and anticipated amount of physical movement at the reference points.

Ensure data includes the following:

a. Mountings

b. Bases

c. Isolators

d. Floor-Mounted Piping

e. Vertical Piping

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings

Outline Drawings

SD-03 Product Data

Equipment and Performance Data

Isolators

SD-06 Test Reports

Type of Isolator

Type of Base

Allowable Deflection

Measured Deflection

PART 2 PRODUCTS

2.1 TYPE OF VIBRATION-ISOLATION PROVISIONS

Design for vibration isolation using ASHRAE HVAC APP IP HDBK, Chapter 37, as applicable to the following sections.

Submit test reports for testing vibration isolation for each type of isolator and each type of base, and meet referenced standards contained within this section. Include in test reports allowable deflection and measured deflection also meeting referenced standards within this section.

2.1.1 Materials

Rubber must be natural rubber. Elastomer must be chloroprene. Shore A durometer measurement of both materials and range between 40 and 60.

Inorganic materials such as precompressed, high-density, fibrous glass encased in a resilient moisture-impervious membrane may be used in lieu of specified natural rubber and elastomers. Where this substitution is made, ensure specified deflections are modified by the manufacturing source to accommodate physical characteristics of inorganic materials and to provide equal or better vibration isolation.

Ensure weather-exposed metal vibration-isolator parts are corrosion protected. Chloroprene coat springs.

2.1.2 Mountings

Provide the following mountings:

Type D: Partially housed type, containing one or more vertically restrained springs with at least 0.50 inch clearance maintained around springs, with adjustable limit stops, 0.25-inch thick Type A base elastomer pads, and accessories.

Type F: Combination spring and rubber-in-shear or elastomer-in-shear steel framed for hanger-rod mounting. Minimum total static deflection must be 1 inch.

2.1.3 Bases

Provide the following bases:

Type U: Unit isolators without rails, structural-steel bases, or inertia blocks.

Type S: Steel roofcurb base common to a supported assembly, made from welded-joint steel with closed-perimeter configuration, isolators attached to top rail and base curb.

Height of steel curb members must be sufficient to provide stiffness required to maintain equipment manufacturer's recommended alignment and duty efficiency of power-transmission components. Height of steel member must not result in member deflection at midpoint of unsupported

span of more than 1/1440th of the span between isolators. Minimum height must be 5 inches.

Type CIB: Concrete inertia blocks must be common to the entire assembly, and have welded-joint construction, mill-rolled structural-steel perimeters, welded-in No. 4 reinforcing bars 8 inches on center each way near the bottom of the block, outrigger-isolator mounting provisions, anchor bolts, and be filled with 3,000 psi cured-strength concrete.

Configuration of inertia bases must be rectangular to accommodate equipment supported.

Minimum thickness of inertia base, in addition to providing suitable mass, must be sufficient to provide stiffness to maintain equipment manufacturer's recommended alignment and duty efficiency of power-transmission components. Minimum thickness must be sufficient to result in base deflection at midpoint of unsupported span of not more than 1/1440th of the span between isolators. Minimum thickness, the preceding requirements not withstanding, must be 8 percent of the longest base dimension.

Pumps with flexible couplings must not have inertia bases less than 8 inches thick.

Minimum mass of concrete inertia block must be equal in weight to supported equipment.

2.2 VIBRATION-ISOLATION SYSTEMS APPLICATION

Vibration isolation design per ASHRAE HVAC APP IP HDBK, Chapter 37 and ASA S2.40.

2.2.1 Centrifugal Pumps

No vibration isolators.

2.2.2 Rooftop Air Conditioning Unit

Vibration isolating roof curb assembly: Isolator Type D. Refer to schedule on drawings.

2.3 PIPE VIBRATION ISOLATION

Type G: Provide isolators with in-series contained steel springs and preformed fibrous-glass or chloroprene-elastomer elements for connecting to structure attachments. Load devices by supported system during operating conditions to produce a minimum spring and elastomer static deflection of 1 inch and 3/8 inch, respectively.

2.3.1 Vertical Piping

Type L: Provide isolators which are pipe base-support devices with one or more contained steel springs. Load devices by supported system during operating conditions to produce a minimum static deflection of 1 inch. Equip devices with precompression and vertical-limit features, as well as a minimum 1/4-inch thick elastomer sound pad and isolation washers, for mounting to floor.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment in accordance with manufacturer's recommendations.

Roof curb rail must be raised not less than 1 inch above the base curb and be level when equipment supported is under operating load.

Ensure vibration-isolation installation and deflection testing after equipment start-up is directed by a competent representative of the manufacturer.

3.2 TESTS AND REPORTS

Ensure vibration-isolation devices are deflection tested. Submit test reports in accordance with paragraph entitled, "Submittal Procedures," substantiating that all equipment has been isolated as specified and that minimum specified deflections have been met. Make all measurements in the presence of the COR.

-- End of Section --

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

This section covers testing, adjusting, and balancing (TAB) of heating, ventilating, and air-conditioning (HVAC) air and water distribution systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S1.11	Specification for Octave- Band and Fractional-Octave-Band Analog and Digital Filters (ASA 65)
ASA S1.4	Specification for Sound Level Meters (ASA 47)

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 203	Field Performance Measurements of Fan Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 62.1	Ventilation for Acceptable Indoor Air Quality
ASHRAE HVAC APP IP HDBK	HVAC Applications Handbook, I-P Edition

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	National Standards for Total System Balance
AABC MN-4	Test and Balance Procedures

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB MASV	Procedural Standards for Measurements and Assessment of Sound and Vibration
NEBB PROCEDURAL STANDARDS	Procedural Standards for TAB (Testing, Adjusting and Balancing) Environmental Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1143	HVAC Air Duct Leakage Test Manual, 1st Edition
SMACNA 1780	HVAC Systems - Testing, Adjusting and Balancing, 3rd Edition
SMACNA 1858	HVAC Sound And Vibration Manual - First Edition

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82	Protection of Stratospheric Ozone

1.3 DEFINITIONS

a. AABC: Associated Air Balance Council.

b. COR: Contracting Officer's Representative.

c. DALT: Duct air leakage test

d. DALT'd: Duct air leakage tested

e. HVAC: Heating, ventilating, and air conditioning; or heating, ventilating, and cooling.

f. NEBB: National Environmental Balancing Bureau

g. Out-of-tolerance data: Pertains only to field acceptance testing of Final DALT or TAB report. When applied to DALT work, this phase means "a leakage rate measured during DALT field acceptance testing which exceeds the leakage rate allowed by DALT schedule on drawings." When applied to TAB work this phase means "a measurement taken during TAB field acceptance testing which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the TAB Report for a specific parameter."

h. Sound measurements terminology: Defined in AABC MN-1, NEBB MASV, or SMACNA 1858 (TABB).

i. TAB: Testing, adjusting, and balancing (of HVAC systems).

j. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed.

k. TAB Agency: TAB Firm

l. TAB team field leader: TAB team field leader

m. TAB team supervisor: TAB team engineer.

n. TAB team technicians: TAB team assistants.

o. TABB: Testing Adjusting and Balancing Bureau.

1.3.1 Similar Terms

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results.

The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS

Contract Term	AABC Term	NEBB Term	TABB Term
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems	International Standards for Environmental Systems Balance
TAB Specialist	TAB Engineer	TAB Supervisor	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures.	Field Readiness Check & Prelim. Field Procedures

1.4 WORK DESCRIPTION

The work includes duct air leakage testing (DALT) and testing, adjusting, and balancing (TAB) of new and existing heating, ventilating, and cooling (HVAC) air and water distribution systems including equipment and performance data, ducts, and piping which are located within, on, under, between, and adjacent to buildings, including records of existing conditions.

Perform TAB in accordance with the requirements of the TAB procedural standard recommended by the TAB trade association that approved the TAB Firm's qualifications. Comply with requirements of AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 (TABB) as supplemented and modified by this specification section. All recommendations and suggested practices contained in the TAB procedural standards are considered mandatory.

Conduct DALT and TAB of the indicated existing systems and equipment and submit the specified DALT and TAB reports for approval. Conduct DALT testing in compliance with the requirements specified in SMACNA 1143, except as supplemented and modified by this section. Conduct DALT and TAB

work in accordance with the requirements of this section.

1.4.1 Air Distribution Systems

Test, adjust, and balance system (TAB) in compliance with this section. Obtain COR's written approval before applying insulation to exterior of air distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.4.2 Water Distribution Systems

TAB system in compliance with this section. Obtain COR's written approval before applying insulation to water distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

At Contractor's option and with COR's written approval, the piping systems may be insulated before systems are TAB'd.Terminate piping insulation immediately adjacent to each flow control valve, automatic control valve, or device. Seal the ends of pipe insulation and the space between ends of pipe insulation and piping, with waterproof vapor barrier coating.

After completion of work under this section, insulate the flow control valves and devices as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.4.3 TAB SCHEMATIC DRAWINGS

Show the following information on TAB Schematic Drawings:

a. A unique number or mark for each piece of equipment or terminal.

b. Air quantities at air terminals.

c. Air quantities and temperatures in air handling unit schedules.

d. Water quantities and temperatures in thermal energy transfer equipment schedules.

e. Water quantities and heads in pump schedules.

f. Water flow measurement fittings and balancing fittings.

g. Ductwork Construction and Leakage Testing Table that defines the DALT test requirements, including each applicable HVAC duct system ID or mark, duct pressure class, duct seal class, and duct leakage test pressure.

The Testing, Adjusting, and Balancing (TAB) Specialist must review the Contract Plans and Specifications and advise the COR of any deficiencies that would prevent the effective and accurate TAB of the system, including records of existing conditions, and systems readiness check. The TAB Specialist must provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

Submit three copies of the TAB Schematic Drawings and Report Forms to the COR, no later than 21 days prior to the start of TAB field measurements.

1.4.4 Related Requirements

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.

Specific requirements relating to Reliability Centered Maintenance (RCM) principals and Predictive Testing and Inspection (PTI), by the construction contractor to detect latent manufacturing and installation defects must be followed as part of the Contractor's Quality Control program. Refer to the paragraph titled "Sustainability" for detailed requirements.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Records of Existing Conditions

TAB Firm

Designation of TAB team assistants

Designation of TAB team engineer or TAB Specialist

Designation of TAB team field leader

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms

SD-03 Product Data

Equipment and Performance Data

TAB Related HVAC Submittals

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB team engineer and assistant.

TAB Procedures

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration

Systems Readiness Check

TAB Execution

TAB Verification

SD-06 Test Reports

DALT and TAB Work Execution Schedule

DALT and TAB Procedures Summary

Design review report

Pre-Final DALT report

Final DALT report

TAB report

SD-07 Certificates

Independent TAB agency and personnel qualifications

Advance notice of Pre-Final DALT field work

Completed Pre-Final DALT Work Checklist

Advance Notice of TAB Field Work

Completed Pre-TAB Work Checklist

TAB Firm

Independent TAB Agency and Personnel Qualifications

DALT and TAB Submittal and Work Schedule

Design review report

Pre-field DALT preliminary notification

Pre-field TAB engineering report

Advanced notice for TAB field work

Prerequisite HVAC Work Check Out List

1.6 QUALITY ASSURANCE

1.6.1 Independent TAB Agency and Personnel Qualifications

To secure approval for the proposed agency, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including design, furnishing equipment, or construction. Further, submit the following, for the agency, to COR for approval:

a. Independent AABC or NEBB or TABB TAB agency:

TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification; or TABB certification number and expiration date of current certification.

TAB team supervisor: Name and copy of AABC or NEBB or TABB TAB supervisor certificate and expiration date of current certification.

TAB team field leader: Name and documented evidence that the team

field leader has satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

TAB team field technicians: Names and documented evidence that each field technician has satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

Current certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew Certifications which expire prior to completion of the TAB work, in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification are not to perform TAB work on this contract.

b. TAB Team Members: TAB team approved to accomplish work on this contract are full-time employees of the TAB agency. No other personnel is allowed to do TAB work on this contract.

c. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the COR.

1.6.2 TAB Standard

Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard are considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practical, to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations.

All quality assurance provisions of the TAB Standard such as performance guarantees are part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures must be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are considered mandatory, including the latest requirements of ASHRAE 62.1.

1.6.3 Sustainability

Contractor must submit the following as part of the Quality Control Plan for acceptance testing:

a. List all test equipment to be used, including its manufacturer,model number, calibration date, and serial number.

b. Certificates of test personnel qualifications and certifications. Provide certification of compliance with 40 CFR 82.

c. Proof of equivalency if the contractor desites to substitute a test requirement.

Perform the following PTI as an integral part of the TAB process per the most recent edition of the NASA RCBEA GUIDE:

Fans:
a. Vibration Analysis
b. Balance Test and Measurement
c. Alignment (laser preferred)
d. Lubricating Oil Test
e. Thermodynamic Performance Test

Heat Exchangers (General):
a. Hydrostatic Test
b. Airborne Ultrasonic Test
c. Thermodynamic Performance Test
d. Infrared Thermography (optional)

Heat Exchangers (Condenser Air Cooled):
a. Hydrostatic Test
b. Thermodynamic Performance Test
c. Airborne Ultrasonic Test (optional)
d. Pulse Ultrasonic Test (optional)
e. Infrared Thermography (optional)

HVAC Ducts:
a. Operational Test
b. Ductwork Leak Testing (DALT); Pre-Final DALT report, Final DALT report

Valves:
a. Hydrostatic Test
b. Airborne Ultrasonic Test (optional)
c. Thermodynamic Performance Test (optional)
d. Infrared Thermography (optional)

1.6.4 Qualifications

1.6.4.1 TAB Firm

The TAB Firm must be either a member of AABC or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including TAB of environmental systems and the measuring of sound and vibration in environmental systems.

Certification must be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor must immediately notify the COR and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm will be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor.

These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm must be a prime subcontractor of the Contractor and be financially and corporately independent of the mechanical subcontractor, reporting directly to and paid by the Contractor.

1.6.4.2 TAB Specialist

The TAB Specialist must be either a member of AABC,an experienced technician of the Firm certified by the NEBB, or a Supervisor certified by the TABB. The certification must be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, immediately notify the COR and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist will be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.6.4.3 TAB Specialist Responsibilities

TAB Specialist responsibilities include all TAB work specified herein and in related sections under his direct guidance. The TAB specialist is required to be onsite on a daily basis to direct TAB efforts.

1.6.4.4 TAB Related HVAC Submittals

The TAB Specialist must prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. Accompany the submittals identified on this list with a letter of approval signed and dated by the TAB Specialist when submitted to the Government. Ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

1.6.5 Responsibilities

The Contractor is responsible for ensuring compliance with the requirements of this section. The following delineation of specific work responsibilities is specified to facilitate TAB execution of the various work efforts by personnel from separate organizations. This breakdown of specific duties is specified to facilitate adherence to the schedule listed in paragraph entitled "TAB Submittal and Work Schedule."

1.6.5.1 Contractor

a. TAB personnel: Ensure that the DALT work and the TAB work is accomplished by a group meeting the requirements specified in paragraph entitled "TAB Personnel Qualification Requirements."

b. Pre-DALT/TAB meeting: Attend the meeting with the TAB Supervisor, and ensure that a representative is present for the sheetmetal contractor, mechanical contractor, electrical contractor, and automatic temperature controls contractor.

c. HVAC documentation: Furnish one complete set of the following

HVAC-related documentation to the TAB agency:

1. Contract drawings and specifications

2. Approved submittal data for equipment

3. Construction work schedule

4. Up-to-date revisions and change orders for the previously listed items

d. Submittal and work schedules: Ensure that the schedule for submittals and work required by this section and specified in paragraph entitled "TAB Submittal and Work Schedule," is met.

e. Coordination of supporting personnel:

Provide the technical personnel, such as factory representatives or HVAC controls installer required by the TAB field team to support the DALT and the TAB field measurement work.

Provide equipment mechanics to operate HVAC equipment and ductwork mechanics to provide the field designated test ports to enable TAB field team to accomplish the DALT and the TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in the DALT and the TAB field work.

Conversely, ensure that the HVAC controls installer has required support from the TAB team field leader to complete the controls check out.

f. Deficiencies: Ensure that the TAB Agency supervisor submits all Design/Construction deficiency notifications directly to the Contracting officer within 3 days after the deficiency is encountered. Further, ensure that all such notification submittals are complete with explanation, including documentation, detailing deficiencies.

g. Prerequisite HVAC work: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as prerequisite work items, the deficiencies pointed out by the TAB team supervisor in the design review report.

h. Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's pre-field engineering report. Do not allow the TAB team to commence TAB field work until all of the following are completed.

1. HVAC system installations are fully complete.

2. HVAC prerequisite checkout work lists specified in the paragraph "Pre-Field TAB Engineering Report" are completed, submitted, and approved. Ensure that the TAB Agency gets a copy of the approved prerequisite HVAC work checklist.

3. DALT field checks for all systems are completed.

4. HVAC system filters are clean TAB field work.

i. Advance notice: Furnish to the COR with advance written notice for the commencement of the DALT field work and for the commencement of the TAB field work.

j. Insulation work: For required DALT work , ensure that insulation is not installed on ducts to be DALT'd until DALT work on the subject ducts is complete. Later, ensure that openings in duct and machinery insulation coverings for TAB test ports are marked, closed and sealed.

1.6.5.2 TAB Agency

Provide the services of a TAB team which complies with the requirements of paragraph entitled "Independent TAB Agency Personnel Qualifications". The work to be performed by the TAB agency is limited to testing, adjusting, and balancing of HVAC air and water systems to satisfy the requirements of this specification section.

1.6.5.3 TAB Team Supervisor

a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.

b. Pre-DALT/TAB meeting: Attend meeting with Contractor.

c. Design review report: Review project specifications and accompanying drawings to verify that the air systems and water systems are designed in such a way that the TAB engineer can accomplish the work in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.

d. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the pre-field engineering report, or during the DALT or TAB field work.

e. Pre-field DALT preliminary notification: Monitor the completion of the duct installation of each system and provide the necessary written notification to the COR.

f. Pre-field engineering report: Utilizing the following HVAC-related documentation; contract drawings and specifications, approved submittal data for equipment, up-to-date revisions and change orders; prepare this report.

g. Prerequisite HVAC work checklist: Ensure the Contractor gets a copy of this checklist at the same time as the pre-field engineering report is submitted.

h. Technical assistance for DALT work.

1. Technical assistance: Provide immediate technical assistance to

TAB field team.

2. DALT field visit: Near the end of the DALT field work effort, visit the contract site to inspect the HVAC installation and the progress of the DALT field work. Conduct a site visit to the extent necessary to verify correct procedures are being implemented and to confirm the accuracy of the Pre-final DALT Report data which has been reported. Also, perform sufficient evaluation to allow the TAB supervisor to issue certification of the final report. Conduct the site visit full-time for a minimum of one 8 hour workday duration.

i. Final DALT report: Certify the DALT report. This certification includes the following work:

1. Review: Review the Pre-final DALT report data. From these field reports, prepare the Certified Final DALT report.

2, TAB Verification: Verify adherence, by the TAB field team, to the procedures specified in this section.

j. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.

1. TAB field visit: Near the end of the TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workday duration. Review the TAB final report data and certify the TAB final report.

k. Certified TAB report: Certify the TAB report. This certification includes the following work:

1. Review: Review the TAB field data report. From this field report, prepare the certified TAB report.

2. Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.

l. Design/Construction deficiencies: Within 3 working days after the TAB Agency has encountered any design or construction deficiencies, the TAB Supervisor must submit written notification directly to the COR, with a separate copy to the Contractor, of all such deficiencies. Provide in this submittal a complete explanation, including supporting documentation, detailing deficiencies. Where deficiencies are encountered that are believed to adversely impact successful completion of TAB, the TAB Agency must issue notice and request direction in the notification submittal.

m. TAB Field Check: The TAB team supervisor must attend and supervise TAB field check.

1.6.5.4 TAB Team Field Leader

a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."

b. Full time: Be present at the contract site when DALT field work or TAB

field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.

c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC Checklist, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

1.6.6 Test Reports

1.6.6.1 Data from DALT Field Work

Report the data for the Pre-final DALT Report and Certified Final DALT Report in compliance the following requirements:

a. Report format: Submit report data on Air Duct Leakage Test Summary Report Forms as shown on Page 6-2 of SMACNA 1143. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Include node numbers in the completed report forms to identify each duct section. The TAB supervisor must review and certify the report.

b. The TAB supervisor must include a copy of all calculations prepared in determining the duct surface area of each duct test section. In addition,provide the ductwork air leak testing (DALT) reports with a copy(s) of the calibration curve for each of the DALT test orifices used for testing.

c. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments must have been calibrated within one year of the date of use in the field. Instrument calibration must be traceable to the measuring standards of the National Institute of Standards and Technology.

d. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.6.6.2 Certified TAB Reports

Submit: TAB Report in the following manner:

a. Report format: Submit the completed pre-field data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data must be typewritten. Handwritten report forms or report data are not acceptable.

b. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as designated in the following list:

1. Control Room 110 . Measure and compile data on a continuous basis for the period in which TAB work affecting those rooms is being done.

2. Measure and record data only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode.

3. Data may be compiled using direct digital controls trend logging where available. Otherwise, temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls must be fully operational a minimum of 24 hours in advance of commencing data compilation. Include the specified data in the TAB Report.

c. System Diagrams: Provide updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations. Use a key numbering system on the diagram which identifies each outlet contained in the outlet airflow report sheets.

d. Static Pressure Profiles: Report static pressure profiles for air duct systems including: RTU-1. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. Include the following in the static pressure report data, in addition to AABC/NEBB/TABB required data:

1. Report supply fan inlet and discharge static pressures.

2. Report static pressure drop across hot water coils installed in unit cabinetry or the system ductwork.

3. Report static pressure drop across outside air, return air, and supply air automatic control dampers, both proportional and two-position, installed in unit cabinetry.

4. Report static pressure drop across air filters, acoustic silencers, moisture eliminators, air flow straighteners, air flow measuring stations or other pressure drop producing specialty items installed in unit cabinetry, or in the system ductwork.

   Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows, transitions, offsets, plenums, manual dampers, and branch takes-offs.

5. Report static pressure drop across outside air and relief/exhaust air louvers.

6. Report static pressure readings of supply air, return air, exhaust/relief air, and outside air in duct at the point where these ducts connect to each air moving unit, and also at the following location:

   Main Duct: Take readings at four locations along the full length of the main duct, 25 percent, 50 percent, 75 percent, and 100 percent of the total duct length.

e. Duct Traverses: Report duct traverses for main supply, return, exhaust, relief and outside air ducts. This includes all ducts,

including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency must evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pilot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane."

f. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings must provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

g. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

h. Performance Curves: The TAB Supervisor must include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.

i. Calibration Curves: The TAB Supervisor must include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturi's and flow orifices TAB'd on the job.

1.7 PROJECT/SITE CONDITIONS

1.7.1 TAB Services to Obtain Existing Conditions

Conduct TAB of the indicated existing systems and equipment and submit the specified TAB reports for approval. Conduct this TAB work in accordance with the requirements of this section.

Measure heating water flow to each existing terminal in Building N231. Measure performance of the heating water circulation pump.

1.8 SEQUENCING AND SCHEDULING

1.8.1 DALT and TAB Submittal and Work Schedule

Comply with additional requirements specified in Appendix C: DALT AND TAB SUBMITTAL AND WORK SCHEDULE included at the end of this section

1.8.2 DALT and TAB Submittal and Work Schedule

Submit this schedule,and TAB Schematic Drawings, adapted for this particular contract, to the COR (CO) for review and approval. Include with the submittal the planned calendar dates for each submittal or work item. Resubmit an updated version for CO approval every 90 calendar days days. Compliance with the following schedule is the Contractor's responsibility.

Qualify TAB Personnel: Within 45 calendar days after date of contract award, submit TAB agency and personnel qualifications.

Pre-DALT/TAB Meeting: Within 30 calendar days after the date of

approval of the TAB agency and personnel, meet with the COR.

Design Review Report: Within 60 calendar days after the date of the TAB agency personnel qualifications approval, submit design review report.

Pre-Field DALT Preliminary Notification: On completion of the duct installation for each system, notify the COR in writing within 5 days after completion.

Ductwork Selected for DALT: Within 7 calendar days of Pre-Field DALT Preliminary Notification, the COR will select which of the project ductwork must be DALT'd.

DALT Field Work: Within 48 hours of COR's selection, complete DALT field work on selected.

Submit Pre-final DALT Report: Within one working day after completion of DALT field work, submit Pre-final DALT Report. Separate Pre-final DALT reports may be submitted to allow phased testing from system to system.

DALT Work Field Check: Upon approval of the Pre-final DALT Report, schedule the COR's DALT field check work with the COR.

Submit Final DALT Report: Within 15 calendar days after completion of successful DALT Work Field Check, submit TAB report.

Pre-Field TAB Engineering Report: Within 60 calendar days after approval of the TAB agency Personnel Qualifications, submit the Pre-Field TAB Engineering Report.

Prerequisite HVAC Work Check Out List and Advanced Notice For TAB Field Work: At a minimum of 115 calendar days prior to CCD, submit prerequisite HVAC work check out list certified as complete, and submit advance notice of commencement of TAB field work.

TAB Field Work: At a minimum of 90 calendar days prior to CCD, accomplish TAB field work; submit TAB report; and conduct field check.

Complete TAB Work: Prior to CCD, complete all TAB work.

1.8.2.1 Design Review Report

Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

1.8.2.2 Pre-Field DALT Preliminary Notification

Notification: On completion of the installation of each duct system indicated to be DALT'd, notify the COR in writing within 7 calendar days after completion.

1.8.2.3 Pre-Field TAB Engineering Report

Submit report containing the following information:

a. Step-by-step TAB procedure:

1. Strategy: Describe the method of approach to the TAB field work from start to finish. Include in this description a complete methodology for accomplishing each seasonal TAB field work session.

2. Air System Diagrams: Use the contract drawings and duct fabrication drawings if available to provide air system diagrams in the report showing the location of all terminal outlet supply, return, exhaust and transfer registers, grilles and diffusers. Use a key numbering system on the diagrams which identifies each outlet contained in the outlet airflow report sheets. Show intended locations of all traverses and static pressure readings.

3. Procedural steps: Delineate fully the intended procedural steps to be taken by the TAB field team to accomplish the required TAB work of each air distribution system and each water distribution system. Include intended procedural steps for TAB work for subsystems and system components.

b. Pre-field data: Submit AABC or NEBB or SMACNA 1780 data report forms with the following pre-field information filled in:

1. Design data obtained from system drawings, specifications, and approved submittals.

2. Notations detailing additional data to be obtained from the contract site by the TAB field team.

3. Designate the actual data to be measured in the TAB field work.

4. Provide a list of the types of instruments, and the measuring range of each, which are anticipated to be used for measuring in the TAB field work. By means of a keying scheme, specify on each TAB data report form submitted, which instruments will be used for measuring each item of TAB data. If the selection of which instrument to use, is to be made in the field, specify from which instruments the choice will be made. Place the instrument key number in the blank space where the measured data would be entered.

c. Prerequisite HVAC work checkout list: Provide a list of inspections and work items which are to be completed by the Contractor. This list must be acted upon and completed by the Contractor and then submitted and approved by the COR prior to the TAB team coming to the contract site.

At a minimum, a list of the applicable inspections and work items listed in the NEBB PROCEDURAL STANDARDS, Section III, "Preliminary TAB Procedures" under paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" must be provided for each separate system to be TAB'd.

1.9 WARRANTY

Furnish workmanship and performance warranty for the DALT and TAB system

work performed for a period not less than 2 years from the date of Government acceptance of the work; issued directly to the Government. Include provisions that if within the warranty period the system shows evidence of major performance deterioration, or is significantly out of tolerance, resulting from defective TAB or DALT workmanship, the corrective repair or replacement of the defective materials and correction of the defective workmanship is the responsibility of the TAB firm. Perform corrective action that becomes necessary because of defective materials and workmanship while system TAB and DALT is under warranty 7 days after notification, unless additional time is approved by the COR. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the TAB firm. The Contractor must also provide a 2 year contractor installation warranty.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 WORK DESCRIPTIONS OF PARTICIPANTS

Comply with requirements of this section as specified in Appendix A WORK DESCRIPTIONS OF PARTICIPANTS.

3.2 PRE-DALT/TAB MEETING

Meet with the COR's technical representative (COR) and the designing engineer of the HVAC systems to develop a mutual understanding relative to the details of the DALT work and TAB work requirements. Ensure that the TAB supervisor is present at this meeting. Requirements to be discussed include required submittals, work schedule, and field quality control.

3.3 DALT PROCEDURES

3.3.1 Instruments, Consumables and Personnel

Provide instruments, consumables and personnel required to accomplish the DALT field work. Follow the same basic procedure specified below for TAB Field Work, including maintenance and calibration of instruments, accuracy of measurements, preliminary procedures, field work, workmanship and treatment of deficiencies. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

3.3.2 Advance Notice of Pre-Final DALT Field Work

On completion of the installation of each duct system indicated to be DALT'd, notify the COR in writing prior to the COR's duct selection field visit.

3.3.3 Ductwork To Be DALT'd

From each duct system indicated as subject to DALT, the COR will randomly select sections of each completed duct system for testing by the Contractor's TAB Firm.

It is acceptable for an entire duct system to be DALT'd instead of disassembling that system in order to DALT only the portion specified above.

3.3.4 DALT Testing

Perform DALT on the HVAC duct sections of each system as noted on schedule . Use the duct class, seal class, leakage class and the leak test pressure data indicated on the drawings, to comply with the procedures specified in SMACNA 1143.

In spite of specifications of SMACNA 1143 to the contrary, DALT ductwork of construction class of 3-inch water gauge static pressure and below if indicated to be DALT'd.

3.3.5 Pre-final DALT Report

After completion of the DALT work, prepare a Pre-final DALT Report meeting the additional requirements specified in Appendix B REPORTS - DALT and TAB. Data required by those data report forms shall be furnished by the TAB team. Prepare the report neatly and legibly; the Pre-final DALT report shall provide the basis for the Final DALT Report.

TAB supervisor shall review, approve and sign the Pre-Final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the COR that the field check of the Pre-Final DALT Report data can commence.

After completion of the DALT work, prepare a Pre-final DALT Report using the reporting forms specified. TAB team to furnish data required by those data report forms . Prepare the report neatly and legibly; the Pre-final DALT report is the basis for the Final DALT Report. TAB supervisor must review and certify the Pre-final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the COR that the field check of the Pre-final DALT Report data can commence.

3.3.6 Quality Assurance - COR DALT Field Acceptance Testing

In the presence of the COR and TAB team field leader, verify for accuracy Pre-final DALT Report data selected by the COR. For each duct system, this acceptance testing shall be conducted on a maximum of 50 percent of the duct sections DALT'd.

Further, if any data on the Pre-final DALT report form for a given duct section is out-of-tolerance, then field acceptance testing shall be conducted on data for one additional duct section, preferably in the same duct system, in the presence of the COR.

3.3.7 Additional COR Field Acceptance Testing

If any of the duct sections checked for a given system are determined to have a leakage rate measured that exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction class and sealant class, terminate data checking for that section. The associated Pre-final DALT Report data for the given duct system will be disapproved. Make the necessary corrections and prepare a revised Pre-final DALT Report. Reschedule a field check of the revised report data with the COR.

3.3.8 Certified Final DALT Report

On successful completion of all field checks of the Pre-final DALT Report data for all systems, the TAB Supervisor is to assemble, review, certify

and submit the Final DALT Report to the COR for approval.

On successful completion of all field checks of the Pre-Final DALT Report data for all systems, the TAB Supervisor shall assemble, review, approve, sign and submit the Final DALT Report in compliance with Appendix B REPORTS - DALT and TAB to the COR for approval.

3.3.9 Prerequisite for TAB Field Work

Do not commence TAB field work prior to the completion and approval, for all systems, of the Final DALT Report.

3.4 TAB PROCEDURES

3.4.1 TAB Field Work

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents.

That is, comply with the the requirements of AABC MN-1 and AABC MN-4, NEBB PROCEDURAL STANDARDS, NEBB MASV, or SMACNA 1780 (TABB) and SMACNA 1858 (TABB),except as supplemented and modified by this section.

Provide instruments and consumables required to accomplish the TAB work. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. Conduct TAB work, including measurement accuracy, and sound measurement work in conformance with the AABC MN-1 and AABC MN-4, or NEBB TABES and NEBB MASV, or SMACNA 1780 (used by TABB) and SMACNA 1858 sound measurement procedures, except as supplemented and modified by this section.

3.4.2 Preliminary Procedures

Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. TAB engineer is to locate, in the field, test ports required for testing. It is the responsibility of the sheet metal contractor to provide and install test ports as required by the TAB engineer.

3.4.3 TAB Air Distribution Systems

3.4.3.1 Units With Coils

Report heating and cooling performance capacity tests for hot water, and DX coils for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

a. For units with capacities of 7.5 tons (90,000 Btu) or less:

   Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.3.2 Rooftop Air Conditioning

Rooftop air conditioning systems including fans, coils, ducts, plenums, and air distribution devices for supply air, return air, and outside air.

For refrigeration compressors/condensers/condensing units/evaporators, report data as required by NEBB, AABC, and TABB standard procedures, including refrigeration operational data.

3.4.3.3 Exhaust Fans

Exhaust fan systems including fans, ducts, and grilles for exhaust air.

3.4.4 TAB Water Distribution Systems

3.4.4.1 Heating Hot Water

Heating hot water systems including boilers, , pumps, coils, system balancing valves and flow measuring devices. Measure existing systems only.

3.4.5 Sound Measurement Work

3.4.5.1 Areas To Be Sound Measured

In the following spaces, measure and record the sound power level for each octave band listed in ASHRAE HVAC APP IP HDBK Noise Criteria:

a. RTU- System: Rooms: Control Room 110

3.4.5.2 Procedure

Measure sound levels in each room, when unoccupied except for the TAB team, with all HVAC systems that would cause sound readings in the room operating in their noisiest mode. Record the sound level in each octave band. Attempt to mitigate the sound level and bring the level to within the specified ASHRAE HVAC APP IP HDBK noise criteria goals, if such mitigation is within the TAB team's control. State in the report the ASHRAE HVAC APP IP HDBK noise criteria goals. If sound level cannot be brought into compliance, provide written notice of the deficiency to the Contractor for resolution or correction.

3.4.5.3 Timing

Measure sound levels at times prescribed by AABC or NEBB or TABB.

3.4.5.4 Meters

Measure sound levels with a sound meter complying with ASA S1.4, Type 1 or 2, and an octave band filter set complying with ASA S1.11. Use measurement methods for overall sound levels and for octave band sound levels as prescribed by NEBB.

3.4.5.5 Calibration

Calibrate sound levels as prescribed by AABC or NEBB or TABB, except that calibrators emitting a sound pressure level tone of 94 dB at 1000 hertz (Hz) are also acceptable.

3.4.5.6 Background Noise Correction

Determine background noise component of room sound (noise) levels for each (of eight) octave bands as prescribed by AABC or NEBB or TABB.

3.4.6 TAB Work on Performance Tests Without Seasonal Limitations

3.4.6.1 Performance Tests

In addition to the TAB proportionate balancing work on the air distribution systems and the water distribution systems, accomplish TAB work on the HVAC systems which directly transfer thermal energy.

3.4.6.2 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. Record these temperatures at beginning and at the end of data taking.

3.4.6.3 Sound Measurements

Comply with paragraph entitled "Sound Measurement Work," specifically, the requirement that a room must be operating in its noisiest mode at the time of sound measurements in the room. The maximum noise level measurements could depend on seasonally related heat or cooling transfer equipment.

3.4.6.4 Refrigeration Units

For refrigeration compressors/condensers/condensing units, report data as required by NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data.

3.4.6.5 Coils

Report heating and cooling performance capacity tests for hot water, DX coils for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

a. For units with capacities of 7.5 tons (90,000 Btu) or less:

   Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.7 Workmanship

Conduct TAB work on the HVAC systems until measured flow rates are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. This TAB work includes adjustment of balancing valves, balancing dampers, and sheaves. Further, this TAB work includes changing out fan sheaves and pump impellers if required to obtain air and water flow rates specified or indicated. If, with these adjustments and equipment changes, the specified or indicated design flow rates cannot be attained, contact the COR for direction.

3.4.8 Deficiencies

Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph entitled "Workmanship," provide written notice as soon as possible to the Contractor and the COR describing the deficiency and recommended correction.

Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

3.4.9 TAB Reports

Additional requirements for TAB Reports are specified in Appendix B REPORTS - DALT and TAB. After completion of the TAB work, prepare a pre-final TAB report using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms is to be furnished by the TAB team. Except as approved otherwise in writing by the COR, the TAB work and the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship" of this section.

Prepare the report neatly and legibly; the pre-final TAB report is the final TAB report minus the TAB supervisor's review and certification. Obtain, at the contract site, the TAB supervisor's review and certification of the TAB report.

Verbally notify the COR that the field check of the TAB report data can commence; give this verbal notice 48 hours in advance of field check commencement. Do not schedule field check of the TAB report until the specified workmanship requirements have been met or written approval of the deviations from the requirements have been received from the COR.

3.4.10 Quality Assurance - COR TAB Field Acceptance Testing

3.4.10.1 TAB Field Acceptance Testing

During the field acceptance testing, verify, in the presence of the COR, random selections of data (water, air quantities, air motion, sound level readings) recorded in the TAB Report. Points and areas for field acceptance testing are to be selected by the COR. Measurement and test procedures are the same as approved for TAB work for the TAB Report.

Field acceptance testing includes verification of TAB Report data recorded for the following equipment groups:

Group 1: All boilers, and air handling units (rooftop).

Group 2: 25 percent of the supply diffusers, registers, grilles associated with constant volume air handling units.

Group 3: 25 percent of the return grilles, return registers, exhaust grilles and exhaust registers.

Group 4: 100 percent of the supply fans, exhaust fans, and pumps.

Further, if any data on the TAB Report for Groups 2 through 5 is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, additional group data verification is required in the presence of the COR. Verify TAB Report data for one additional piece of equipment in that group. Continue this additional group data verification until out-of-tolerance data ceases to be found.

3.4.10.2 Additional COR TAB Field Acceptance Testing

If any of the acceptance testing measurements for a given equipment group is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, terminate data verification for all affected data for that group. The affected data for the given group will be disapproved. Make the necessary corrections and prepare a revised TAB Report. Reschedule acceptance testing of the revised report data with the COR.
Further, if any data on the TAB Report for a given field acceptance test group is out-of-tolerance, then field test data for one additional field test group as specified herein. Continue this increase field test work until out-of-tolerance data ceases to to be found. This additional field testing is up and above the original 25 percent of the of reported data entries to be field tested.

If there are no more similar field test groups from which to choose, additional field testing from another, but different, type of field testing group must be tested.

3.4.10.3 Prerequisite for Approval

Compliance with the field acceptance testing requirements of this section is a prerequisite for the final COR approval of the TAB Report submitted.

3.5 MARKING OF SETTINGS

Upon the final TAB work approval, permanently mark the settings of HVAC adjustment devices including valves, gauges, splitters, and dampers so that adjustment can be restored if disturbed at any time. Provide permanent markings clearly indicating the settings on the adjustment devices which result in the data reported on the submitted TAB report.

3.6 MARKING OF TEST PORTS

The TAB team is to permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, make these markings on the exterior side of the duct insulation. Show the location of test ports on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

3.7 APPENDICES

Appendix A WORK DESCRIPTIONS OF PARTICIPANTS
Appendix B REPORTS - DALT and TAB
Appendix C DALT AND TAB SUBMITTAL AND WORK SCHEDULE

Appendix A

WORK DESCRIPTIONS OF PARTICIPANTS

The Contractor is responsible for ensuring compliance with all requirements of this specification section. However, the following delineation of specific work items is provided to facilitate and co-ordinate execution of the various work efforts by personnel from separate organizations.

1. Contractor

a. HVAC documentation: Provide pertinent contract documentation to the TAB Firm, to include the following: the contract drawings and specifications; copies of the approved submittal data for all HVAC equipment, air distribution devices, and air/water measuring/balancing devices; the construction work schedule; and other applicable documents requested by the TAB Firm. Provide the TAB Firm copies of contract revisions and modifications as they occur.

b. Schedules: Ensure the requirements specified under the paragraph "DALT and TAB Schedule" are met.

c. Pre-DALT and TAB meeting: Arrange and conduct the Pre-DALT and TAB meeting. Ensure that a representative is present for the sheet metal contractor, the mechanical contractor, the electrical contractor, and the automatic temperature controls contractor.

d. Coordinate Support: Provide and coordinate support personnel required by the TAB Firm in order to accomplish the DALT and TAB field work. Support personnel may include factory representatives, HVAC controls installers, HVAC equipment mechanics, sheet metal workers, pipe fitters, and insulators. Ensure support personnel are present at the work site at the times required.

e. Correct Deficiencies: Ensure the notifications of Construction Deficiencies are provided as specified herein. Refer to the paragraph entitled "Construction Deficiencies." Correct each deficiency as soon as practical with the COR, and submit revised schedules and other required documentation.

f. Pre-TAB Work Checklists: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as pre-TAB work checklist items, the deficiencies pointed out by the TAB team supervisor in the design review report.

   Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's DALT and TAB Work Procedures Summary. Do not allow the TAB team to commence TAB field work until all of the following are completed.

g. Give Notice of Testing: Submit advance notice of TAB field work accompanied by completed prerequisite HVAC Work List

h. Insulation work: Ensure that no insulation is shall not be installed

on ducts to be DALT'd until DALT work on the subject ducts is complete.

Ensure the duct and piping systems are properly insulated and vapor sealed upon the successful completion and acceptance of the DALT and TAB work.

2. TAB Team Supervisor

a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.

b. Schedule: Ensure the requirements specified under the paragraph "DALT and TAB Schedule" are met.

c. Submittals: Provide the submittals specified herein.

d. Pre-DALT/TAB meeting: Attend meeting with Contractor. Ensure TAB personnel that will be involved in the TAB work under this contract attend the meeting.

e. Design Review Report: Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

f. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the DALT and TAB Procedures Summary, the during the DALT or TAB field work.

Ensure the Contractor is properly notified and aware of all support personnel needed to perform the TAB work. Maintain communication with the Contractor regarding support personnel throughout the duration of the TAB field work, including the TAB field acceptance testing checking.

Ensure all inspections and verifications for the Pre-Final DALT and Pre-TAB Checklists are completely and successfully conducted before DALT and TAB field work is performed.

g. Advance Notice: Monitor the completion of the duct system installations and provide the Advance Notice for Pre-Final DALT field work as specified herein.

h. Technical Assistance: Provide technical assistance to the DALT and TAB field work.

i. Deficiencies Notification: Ensure the notifications of Construction Deficiencies are provided as specified herein. Comply with requirements of the paragraph entitled "Construction Deficiencies." Resolve each deficiency as soon as practical and submit revised schedules and other required documentation.

j. Procedures: Develop the required TAB procedures for systems or system

components not covered in the TAB Standard.

3. TAB Team Field Leader

a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."

b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.

c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC work list, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

Appendix B

REPORTS - DALT and TAB

All submitted documentation must be typed, neat, and organized. All reports must have a waterproof front and back cover, a title page, a certification page, sequentially numbered pages throughout, and a table of contents. Tables, lists, and diagrams must be titled. Generate and submit for approval the following documentation:

1. DALT and TAB Work Execution Schedule

Submit a detailed schedule indicating the anticipated calendar date for each submittal and each portion of work required under this section. For each work entry, indicate the support personnel (such as controls provider, HVAC mechanic, etc.) that are needed to accomplish the work. Arrange schedule entries chronologically.

2. DALT and TAB Procedures Summary

Submit a detailed narrative describing all aspects of the DALT and TAB field work to be performed. Clearly distinguish between DALT information and TAB information. Include the following:

a. A list of the intended procedural steps for the DALT and TAB field work from start to finish. Indicate how each type of data measurement will be obtained. Include what Contractor support personnel are required for each step, and the tasks they need to perform.

b. A list of the project's submittals that are needed by the TAB Firm in order to meet this Contract's requirements.

c. The schematic drawings to be used in the required reports, which may include building floor plans, mechanical room plans, duct system plans, and equipment elevations. Indicate intended TAB measurement locations, including where test ports need to be provided by the Contractor.

d. The data presentation forms to be used in the report, with the preliminary information and initial design values filled in.

e. A list of DALT and TAB instruments to be used, edited for this project, to include the instrument name and description, manufacturer, model number, scale range, published accuracy, most recent calibration date, and what the instrument will be used for on this project.

f. A thorough checklist of the work items and inspections that need to be accomplished before DALT field work can be performed. The Contractor must complete, submit, and receive approval of the Completed Pre-Final DALT Work Checklist before DALT field work can be accomplished.

g. A thorough checklist of the work items and inspections that need to be accomplished before the TAB field work can be performed. The Contractor must complete, submit, and receive approval of the Completed Pre-TAB Work Checklist before the TAB field work can be accomplished.

i. The checklists specified above shall be individually developed and tailored specifically for the work under this contract. Refer to

NEBB PROCEDURAL STANDARDS, Section III, "Preliminary TAB Procedures" under the paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" for examples of items to include in the checklists.

3. Design Review Report

Submit report containing the following information:

a. Review the contract specifications and drawings to verify that the TAB work can be successfully accomplished in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.

b. Submit a typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the DALT work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. If no deficiencies are evident, state so in the report.

4. Pre-Final DALT Report for COR DALT Field Checks

Report the data for the Pre-Final DALT Report meeting the following requirements:

a. Submit a copy of the approved DALT and TAB Procedures Summary: Provide notations describing how actual field procedures differed from the procedures listed.

b. Report format: Submit a comprehensive report for the DALT field work data using data presentation forms equivalent to the "Air Duct Leakage Test Summary Report Forms" located in the SMACNA 1143. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Node numbers shall be included in the completed report forms to identify each duct section.

c. Calculations: Include a copy of all calculations prepared in determining the duct surface area of each duct test section. Include in the DALT reports copy(s) of the calibration curve for each of the DALT test orifices used for testing.

d. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments are to be calibrated within one year of the date of use in the field; instrument calibration is to be traceable to the measuring standards of the National Institute of Standards and Technology.

e. TAB Supervisor Approval: Include on the submitted report the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

5. Final DALT Report

On successful completion of all COR field checks of the Pre-final DALT Report data for all systems, the TABS Supervisor shall assemble, review, sign and submit the Final DALT Report to the COR for approval.

6. TAB Reports: Submit TAB Report in the following manner:

a. Procedure Summary: Submit a copy of the approved DALT and TAB Procedures Summary. When applicable, provide notations describing how actual field procedures differed from the procedures listed.

b. Report format: Submit the completed data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed, approved and signed by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data shall be typewritten. Handwritten report forms or report data are not acceptable.

c. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as designated in the following list:

Control Room 110

1. Data shall be measured and compiled on a continuous basis for the period in which TAB work affecting those rooms is being done.

2. Data shall be measured/recorded only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode. Provide a detailed explanation wherever a final measurement did not achieve the required value.

3. Data may be compiled using direct digital controls trend logging where available. Otherwise, the Contractor shall temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls shall have been fully operational a minimum of 24 hours in advance of commencing data compilation. The specified data shall be included in the TAB Report.

d. Air System Diagrams: Provided updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations.

e. Air Static Pressure Profiles: Report static pressure profiles for air duct systems including: RTU-1. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. The static pressure report data shall include, in addition to AABC or NEBB or TABB required data, the following:

1. Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.

2. Report static pressure drop across DX coils and hot water coils

installed in unit cabinetry or the system ductwork.

3. Report static pressure drop across outside air, return air, and supply air automatic control dampers, both proportional and two-position, installed in unit cabinetry.

4. Report static pressure drop across air filters, acoustic silencers, moisture eliminators, air flow straighteners, air flow measuring stations or other pressure drop producing specialty items installed in unit cabinetry, or in the system ductwork. Examples of these specialty items are smoke detectors.

   Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows, transitions, offsets, plenums, manual dampers, and branch takes-offs.

5. Report static pressure drop across outside air and relief/exhaust air louvers.

6. Report static pressure readings of supply air, return air, exhaust/relief air, and outside air in duct at the point where these ducts connect to each air moving unit.

f. Duct Transverses: Report duct traverses for main supply and return ducts. This shall include all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency shall evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pitot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane".

g. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings shall provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

h. Performance Curves: The TAB Supervisor shall include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.

i. Calibration Curves: The TAB Supervisor shall include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturis and flow orifices TAB'd on the job.

j. Data From TAB Field Work: After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and approval signature, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms shall be furnished by the TAB team. Except as approved otherwise in writing by the COR, the TAB work and thereby the TAB report shall be considered incomplete until the TAB work is accomplished to within the

accuracy range specified in the paragraph entitled "Workmanship."

Appendix C

DALT AND TAB SUBMITTAL AND WORK SCHEDULE

Perform the following items of work in the order listed adhering to the dates schedule specified below.

Submit TAB Agency and TAB Personnel Qualifications: Within 42 calendar days after date of contract award.

Submit the DALT and TAB Work Execution Schedule: within 14 days after receipt of the TAB agency and TAB personnel qualifications approval. Revise and re-submit this schedule 28 days prior to commencement of DALT work and 28 days prior to the commencement of TAB work.

Submit the DALT and TAB Work Procedures Summary: within 14 days after receipt of the initial approved DALT and TAB Work Execution Schedule.

Meet with the COR at the Pre-DALT/TAB Meeting: Within 28 calendar days after receipt of the approved initial DALT/TAB Execution Schedule.

Submit Design Review Report: Within 56 calendar days after the receipt of the approved initial DALT and TAB Work Execution Schedule.

Conduct measurements and submit the Record of Existing Facility Conditions: within 28 days after receipt of approved DALT and TAB Work Procedures Summary.

Advance Notice of Pre-Final DALT Field Work: After the completed installation of the HVAC duct system to be DALT'd. Submit to the COR an Advance Notice of Pre-Final DALT Field Work accompanied by the completed Pre-Final DALT Work Checklistchecklist for the subject duct system.

Ductwork Selected for DALT: Within 14 calendar days after receiving an acceptable completed Pre-Final DALT Work Checklist, the COR's technical representative (COR) will select the project ductwork sections to be DALT'd.

DALT Field Work: Within 48 hours of COR's selection, complete DALT field work on selected project ductwork.

Submit Pre-Final DALT Report: Within two working days after completion of DALT field work, submit Pre-final DALT Report. Separate Pre-final DALT reports may be submitted to allow phased testing from system to system.

Quality Assurance - COR DALT Field Checks: Upon approval of the Pre-final DALT Report, the COR's DALT field check work shall be scheduled with the COR.

Submit Final DALT Report: Within 14 calendar days after completion of successful DALT Work Field Check, submit TAB report.

Advance Notice of TAB Field Work: At a minimum of 14 calendar days prior to TAB Field Work, submit advance notice of TAB field work accompanied by completed Pre-TAB Work Checklist.

TAB Field Work: At a minimum of 84 calendar days prior to CCD, accomplish TAB field work.

Submit TAB Report: Within 14 calendar days after completion of TAB field work, submit initial Season 1 TAB report.

Quality Assurance - COR TAB Field Check: 30 calendar days after initial TAB report is approved by the COR, conduct field check.

Complete TAB Work: Prior to CCD, complete all TAB work and submit final.

Receive the approved TAB report: Within 21 calendar days, receive the report from COR approved TAB report.

-- End of Section --

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SECTION 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

This section covers field applied thermal insulation on HVAC and plumbing systems located within, on, under, and adjacent to buildings; above and below ground.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A580/A580M	Standard Specification for Stainless Steel Wire
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 1290	Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
ASTM C 195	Standard Specification for Mineral Fiber Thermal Insulating Cement
ASTM C 449	Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534/C 534M	Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	Standard Specification for Mineral Fiber Pipe Insulation

ASTM C 552	Standard Specification for Cellular Glass Thermal Insulation
ASTM C 553	Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 610	Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation
ASTM C 612	Mineral Fiber Block and Board Thermal Insulation
ASTM C 795	Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C 916	Standard Specification for Adhesives for Duct Thermal Insulation
ASTM C 920	Standard Specification for Elastomeric Joint Sealants
ASTM C 921	Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM E 2231	Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96/E 96M	Standard Test Methods for Water Vapor Transmission of Materials

FM GLOBAL (FM)

FM APP GUIDE	Approval Guide http://www.approvalguide.com/

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-69	Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds	National Commercial & Industrial Insulation Standards

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-3316	Adhesives, Fire-Resistant, Thermal Insulation

UNDERWRITERS LABORATORIES (UL)

UL 723	Test for Surface Burning Characteristics of Building Materials
UL 94	Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.3 SYSTEM DESCRIPTION

1.3.1 General

Provide field-applied insulation and accessories on mechanical systems as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated. Insulation of heat distribution systems outside of buildings shall be as specified.

1.3.2 Surface Burning Characteristics

Unless otherwise specified, insulation shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. Flame spread, and smoke developed indexes, shall be determined by ASTM E 84 or UL 723. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Test specimens shall be prepared and mounted according to ASTM E 2231. Insulation materials located exterior to the building perimeter are not required to be fire rated.

1.3.3 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided that the materials meets all other requirements of this section. The minimum recycled material content of the following insulation are:

Rock Wool - 75 percent slag of weight
Fiberglass - 20-25 percent glass cullet by weight
Rigid Foam - 9 percent recovered material

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Submit the three SD types, SD-02 Shop Drawings, SD-03 Product Data, and SD-08 Manufacturer's Instructions at the same time for each system.

SD-02 Shop Drawings

MICA Plates
Pipe Insulation Systems and Associated Accessories
Duct Insulation Systems and Associated Accessories
Equipment Insulation Systems and Associated Accessories

SD-03 Product Data

Certification
Pipe Insulation Systems
Duct Insulation Systems
Equipment Insulation Systems

SD-08 Manufacturer's Instructions

Pipe Insulation Systems
Duct Insulation Systems
Equipment Insulation Systems

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualification

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.5.2 Sustainable Design Certification

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.6 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The COR may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means. Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material. Insulation packages and containers shall be asbestos free.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit a complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each mechanical system requiring insulation shall be included. The product data must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this

solicitation. Materials furnished under this section shall be submitted together in a booklet and in conjunction with the MICA plates booklet (SD-02). Annotate the product data to indicate which MICA plate is applicable. Provide insulation systems in accordance with the approved MICA National Insulation Standards plates as supplemented by this specification. Provide field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems which are located within, on, under, and adjacent to buildings; and for plumbing systems. Insulation shall be CFC and HCFC free.

2.2 MATERIALS

Provide insulation that meets or exceed the requirements of California Energy Code for HVAC ducts, heating water piping, and plumbing piping. Provide insulation for other pipes as required on drawings. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free.

2.2.1 Adhesives

2.2.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I.

2.2.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C 195.

2.2.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. Lagging adhesives shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. Adhesive shall be MIL-A-3316, Class 1, pigmented white or red and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or Class 2 for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations for pipe and duct insulation. Submit and display, after approval of materials, actual sections of installed systems, properly insulated in accordance with the specification requirements. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The COR will inspect display sample sections at the jobsite. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

a. Pipe Insulation Display Sections: Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric waterways and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used in the boiler plant.

2.2.2 Contact Adhesive

Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation shall be used to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices. Provide product recognized under UL 94 and listed in FM APP GUIDE.

2.2.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

2.2.4 Corner Angles

2.2.4.1 General

Nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be ASTM B209, Alloy 3003, 3105, or 5005.

2.2.4.2 Fittings

Fabricated Fittings are the prefabricated fittings for pipe insulation systems.

2.2.5 Finishing Cement

ASTM C 449: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must comply with ASTM C 795.

2.2.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth, with 20X20 maximum mesh size, and glass tape shall have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces/square yard. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing an

anti-microbial additive.

2.2.7 Staples

Outward clinching type monel or ASTM A167, Type 304 or 316 stainless steel.

2.2.8 Jackets

2.2.8.1 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 by 0.016 inch aluminum matching jacket material. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

2.2.8.2 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

2.2.8.3 Weatherproofing Jacket

Weatherproofing jacket shall be laminated self-adhesive, greater than 3 plies standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive); with 0.0000 permeability when tested in accordance with ASTM E 96/E 96M; heavy duty, white or natural; and UV resistant. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and excellent WVT.

2.2.9 Vapor Retarder Required

2.2.9.1 White Vapor Retarder All Service Jacket (ASJ)

Standard reinforced fire retardant jacket for use on hot/cold pipes, ducts, or equipment.

2.2.10 Vapor Retarder Not Required

ASTM C 921, Type II, Class D, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable. Jacket shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.2.11 Wire

Soft annealed ASTM A580/A580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2.12 Insulation Bands

Insulation bands shall be 1/2 inch wide; 26 gauge stainless steel.

2.2.13 Sealants

Sealants shall be butyl polymer type, styrene-butadiene rubber type, or butyl type of sealants. Sealants shall have a maximum moisture vapor transmission of 0.02 perms, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.3 PIPE INSULATION SYSTEMS

Insulation materials shall conform to Table 1. Insulation thickness shall be as listed in Table 2 . Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS. Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.3.1 Aboveground Cold Pipeline (-30 to 60 deg. F)

Insulation for indoor, exposed or concealed applications, shall be as follows:

a. Flexible Elastomeric Cellular Insulation: ASTM C 534/C 534M, Grade 1, Type I or II. Type II shall have vapor retarder/vapor barrier skin on one or both sides of the insulation.

2.3.2 Aboveground Hot Pipeline (Above 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

a. Mineral Fiber: ASTM C 547, Types I, II or III.

b. Calcium Silicate: ASTM C 533, Type I indoor only, or outdoors above 250 degrees F pipe temperature.

c. Cellular Glass: ASTM C 552, Type II and Type III.

d. Perlite Insulation: ASTM C 610

2.4 DUCT INSULATION SYSTEMS

2.4.1 Duct Insulation

Provide factory-applied insulation with insulation manufacturer's standard reinforced fire-retardant vapor barrier, with identification of installed thermal resistance (R) value and out-of-package R value.

2.4.1.1 Rigid Insulation

Rigid mineral fiber in accordance with ASTM C 612, Class 2 (maximum surface temperature 400 degrees F), 3 pcf average, 1-1/2 inch thick, Type IA, IB, II, III, and IV.

2.4.1.2 Blanket Insulation

Blanket flexible mineral fiber insulation conforming to ASTM C 553, Type 1, Class B-3, 3/4 pcf nominal, 2.0 inches thick or Type II up to 250 degrees F. Also ASTM C 1290 Type III may be used.

2.4.2 Duct Insulation Jackets

2.4.2.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service.

2.5 EQUIPMENT INSULATION SYSTEMS

Insulate equipment and accessories as specified in Tables 4 and 5. In outside locations, provide insulation 1/2 inch thicker than specified. Increase the specified insulation thickness for equipment where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface. Submit a booklet containing manufacturer's published installation instructions for the insulation systems in coordination with the submitted MICA Insulation Stds plates booklet. Annotate their installation instructions to indicate which product data and which MICA plate are applicable. The instructions must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. A booklet is also required by paragraphs titled: Pipe Insulation Systems and Duct Insulation Systems.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.1.2 Painting and Finishing

Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.1.3 Welding

No welding shall be done on piping, duct or equipment without written approval of the COR.

3.1.4 Pipes/Ducts/Equipment which Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items, as specified.

3.2 PIPE INSULATION SYSTEMS INSTALLATION

Install pipe insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder/barrier, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

a. Pipe used solely for fire protection.

b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.

c. Sanitary drain lines.

d. Air chambers.

e. Adjacent insulation.

f. ASME stamps.

g. Access plates of fan housings.

h. Cleanouts or handholes.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

a. Pipe insulation shall be continuous through the sleeve.

b. Where pipes penetrate interior walls, the jacket shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band. Moisture retarder shall be provided over the insulation wherever penetrations require sealing.

c. For hot water pipes supplying lavatories or other similar heated service that requires insulation, the insulation shall be terminated on the backside of the finished wall. The insulation termination shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. Glass tape seams shall overlap 1 inch. The annular space between the pipe and wall penetration shall be caulked with approved fire stop material. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inches.

d. For domestic cold water pipes supplying lavatories or other similar cooling service that requires insulation, the insulation shall be terminated on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). The insulation shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch. The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. The annular space between the outer surface of the pipe insulation and the wall penetration shall be caulked with an approved fire stop material having vapor retarder properties. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inches.

3.2.1.3 Pipes Passing Through Hangers

a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed, or factory insulated hangers (designed with a load bearing core) can be used.

b. Horizontal pipes larger than 2 inches at 60 degrees F and above shall be supported on hangers in accordance with MSS SP-69.

c. Horizontal pipes larger than 2 inches shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass, prefabricated insulation pipe hangers, perlite above 80 degrees F), or the necessary strength polyisocyanurate shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield.

d. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360-degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. The vertical weight of the pipe shall

be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

e. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 1-1/2 inches, and shall be sealed as required for the pipe jacket.

3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

3.2.1.5 Pipes in high abuse areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, and mechanical rooms, aluminum jackets shall be utilized. Pipe insulation to the 6 foot level shall be protected.

3.2.1.6 Pipe Insulation Material and Thickness

TABLE 1
Insulation Material For Piping (°F)

Service	Material	Spec-Type-Class			Vapor Retard/ Vapor Barr'r Required
Heating Hot Water Supply & Return (Max 250°F)	Mineral Fiber	ASTM C 547	I	1	No
Cold Domestic Water Piping (outdoors)	Flex Elast Cell'r	ASTM C 534/C 534M	I		No
Hot Domestic Water Supply Piping (Max. 200°F)	Mineral Fiber	ASTM C 547	I	1	No

TABLE 1
Insulation Material For Piping (°F)

Service	Material	Spec-Type-Class	Vapor Retard/ Vapor Barr'r Required
Exposed Lav'ry Drains, Expo'd Hot Domestic Water Piping	Flex Elast Cell'r	ASTM C 534/C 534M I	No
A/C condensate Drain Located Inside Bldg.	Flex Elast Cell'r	ASTM C 534/C 534M I	No
Steam, Feedwater, Other Process Piping:			
	Mineral Fiber	ASTM C 547 I 2	No
	Calcium Silicate	ASTM C 533 I	No
	Perlite	ASTM C 610	No
	Cellular Glass	ASTM C 552	No

TABLE 2
Piping Insulation Thickness (inch and °F)

Service	Material	Thickness (Inches)
Heating Hot Water Supply & Return (Max. 250°F)	Mineral Fiber	1.5
Cold Domestic Water Piping (outdoors)	Flex Elas Cell'r	1
Hot Domestic Water Supply Piping (Max 200°F)	Mineral Fiber	1

TABLE 2
Piping Insulation Thickness (inch and °F)

Service	Material	Thickness (Inches)
Exposed Lavatory Drains, Exposed Domestic Hot Water Piping	Flex Elas Cell'r	0.5
A/C condensate Drain Located Inside Bldg.	Flex Elas Cell'r	1
Steam, Boiler Feedwater, Other Process Piping: As scheduled on drawings		

3.2.2 Aboveground Cold Pipelines

The following cold pipelines for minus 30 to plus 60 degrees F, shall be insulated in accordance with Table 2 except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted. This includes but is not limited to the following:

a. Domestic cold water outdoors

b. Air conditioner condensate drains.

3.2.2.1 Insulation Material and Thickness

Insulation thickness for cold pipelines shall be determined using Table 2.

3.2.2.2 Installing Insulation for Straight Runs Hot and Cold Pipe

a. Insulation shall be applied to the pipe with joints tightly butted. All butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating.

b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3 inches wide shall be provided for circumferential joints.

c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. If staples are used, they shall be sealed in accordance with item "e." below. Note that staples are not required with cellular glass systems.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 and 120 degrees F during installation. The

lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. All staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket. All seams, except those on factory self-seal systems shall be coated with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket.

f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coatingThe patch shall extend not less than 1-1/2 inches past the break.

g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed.

h. Installation of flexible elastomeric cellular pipe insulation shall be by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slit sections over the open ends of piping or tubing. All seams and butt joints shall be secured and sealed with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Insulation shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives shall be used.

3.2.2.3 Insulation for Fittings and Accessories

a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed.

b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow'. Submit a booklet containing completed MICA Insulation Stds plates detailing each insulating system for each pipe, duct, or equipment insulating system, after approval of materials and prior to applying insulation.

1. The MICA plates shall detail the materials to be installed and the specific insulation application. Submit all MICA plates required showing the entire insulating system, including plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. The MICA plates shall present all variations of insulation systems including

locations, materials, vaporproofing, jackets and insulation accessories.

2. If the Contractor elects to submit detailed drawings instead of edited MICA Plates, the detail drawings shall be technically equivalent to the edited MICA Plate submittal.

c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with PVDC or two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches. Fabricated insulation with a factory vapor retarder jacket shall be protected with either . Where fitting insulation butts to pipe insulation, the joints shall be sealed with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.

d. Insulation shall be marked showing the location of unions, strainers, and check valves.

3.2.2.4 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers.

3.2.3 Aboveground Hot Pipelines

3.2.3.1 General Requirements

All hot pipe lines above 60 degrees F, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, shall be insulated in accordance with Table 2. This includes but is not limited to the following:

a. Domestic hot water supply system.

b. Steam.

c. Condensate .

d. Hot water heating.

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type I jacket or field applied aluminum where required or seal welded PVC.

3.2.3.2 Insulation for Fittings and Accessories

a. General. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant. Insulation shall be marked showing the

location of unions, strainers, check valves and other components that would otherwise be hidden from view by the insulation.

b. Precut or Preformed. Precut or preformed insulation shall be placed around all fittings and accessories. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity.

c. Rigid Preformed. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped a minimum of 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, a laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability (greater than 3 ply, standard grade, silver, white, black and embossed aluminum jacket shall be applied.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints shall be sealed with a moisture retarder.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above.

3.3 DUCT INSULATION SYSTEMS INSTALLATION

Install duct insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with California Energy Code. Thickness shall not be less then listed in Table 4.

Table 4 - Minimum Duct Insulation (inches)

Cold Air Ducts	2.0
Warm Air Ducts	2.0

3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Cold Air Duct

Insulation and vapor retarder/vapor barrier shall be provided for the following cold air ducts and associated equipment.

a. Supply air ducts.

b. Return air ducts.

c. Flexible run-outs (field-insulated).

d. Plenums.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf, and rigid type where exposed, minimum density 3 pcf. Insulation for round/oval ducts shall be flexible type, minimum density 3/4 pcf or a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered. Insulation on all concealed duct shall be provided with a factory-applied Type I or II vapor retarder/vapor barrier jacket. Duct insulation shall be continuous through sleeves and prepared openings . Duct insulation and vapor retarder/vapor barrier shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor retarder/vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.3.2.1 Installation on Concealed Duct

a. For rectangular, oval or round ducts, flexible insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder/vapor barrier jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.

e. Where mechanical fasteners are used, self-locking washers shall be installed and the pin trimmed and bent over.

f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less

than 0.0000 perm adhesive tape.

g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.3 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts shall be insulated as specified for cold air duct.

3.3.4 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.3.5 Duct Exposed to Weather

3.4 EQUIPMENT INSULATION SYSTEMS INSTALLATION

Install equipment insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment that must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:

a. Hand-holes.

b. Boiler manholes.

c. Cleanouts.

d. ASME stamps.

e. Manufacturer's nameplates.

f. Balance Test Holes.

3.4.2 Insulation for Hot Equipment

Insulation shall be furnished on equipment handling media above 60 degrees F including the following:

a. Heat exchangers.

b. Pumps handling media above 130 degrees F.

c. Hot water storage tanks.

d. Flash tanks.

e. Feed-water tank and deaerating heaters.

f. Unjacketed boilers or parts of boilers.

g. Boiler flue gas connection from boiler to stack.

3.4.2.1 Insulation

Insulation shall be suitable for the temperature encountered. Shell and tube-type heat exchangers shall be insulated for the temperature of the shell medium.

Insulation thickness for hot equipment shall be determined using Table 6:

Legend

RMF: Rigid Mineral Fiber
FMF: Flexible Mineral Fiber
CS: Calcium Silicate
PL: Perlite
CG: Cellular Glass
FC: Flexible Elastomeric Cellular
PF: Phenolic Foam
PC: Polyisocyanurate Foam

TABLE 6
Insulation Thickness for Hot Equipment (Inches and °F)

Equipment handling steam or media to indicated pressure or temperature limit:	Material	Thickness
	RMF	2.0 inches
	FMF	2.0 inches
less than 250 F	CS/PL	4.0 inches
	CG	3.0 inches
	PF	1.5 inches
	FC (<200F)	1.0 inches
	PC	1.0 inches
	RMF	3.0 inches

TABLE 6
Insulation Thickness for Hot Equipment (Inches and °F)

Equipment handling steam or media to indicated pressure or temperature limit:	Material	Thickness
250 to 400 F	FMF	3.0 inches
	CS/PL	4.0 inches
	CG	4.0 inches
401 to 600 F	RMF	5.0 inches
	FMF	6.0 inches
	CS/PL	6.0 inches
	CG	6.0 inches

3.4.2.2 Insulation of Boiler Stack

Insulate first eight feet of stack above foundation. Bevel insulation neatly around openings and provide sheet metal insulation stop strips around such openings. Apply a skim coat of hydraulic setting cement directly to insulation. Apply a flooding coat of adhesive over hydraulic setting cement, and while still wet, press a layer of glass cloth or tape into adhesive and seal laps and edges with adhesive. Coat glass cloth with adhesive. When dry, apply a finish coat of adhesive at can-consistency so that when dry no glass weave shall be observed. Provide metal jackets for stacks. Apply metal jackets directly over insulation and secure with 3/4 inch wide metal bands spaced on 18 inch centers. Do not insulate name plates. Insulation type and thickness shall be in accordance with the following Table 7.

TABLE 7
Insulation and Thickness (Inches and °F) for
Boiler Stack Pipe

Service & Surface Temperature Range (Degrees F)	Material	Outside Diameter (Inches) >12
Boiler Stack ASTM C 553	Mineral Fiber Class B-3, ASTM C 547 Class 1, or ASTM C 612 Class 1	4
	Calcium Silicate ASTM C 533, Type 1	4
	Cellular Glass ASTM C 552, Type II	2.5

3.4.2.3 Insulation of Pumps

Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Bottom and sides shall be banded to form a rigid housing that does not rest on the pump. Joints between top cover and sides shall fit tightly. The top cover shall have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, making the top cover removable. Two coats of Class I adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line of the removable sections and penetrations.

3.4.2.4 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not greater than 12 inch centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. Insulation on heads of heat exchangers shall be removable. The removable section joint shall be fabricated using a male-female shiplap type joint. Entire surface of the removable section shall be finished as specified.

d. Exposed insulation corners shall be protected with corner angles.

e. On equipment with ribs, such as boiler flue gas connection, draft fans, insulation shall be applied over 6 by 6 inch by 12 gauge welded wire fabric which has been cinched in place, or if approved by the COR, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 by 2 inch washers or shall be securely banded or wired in place on 12 inch (maximum) centers.

f. Upon completion of installation of insulation, penetrations shall be caulked. Two coats of adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.3 Equipment Exposed to Weather

3.4.3.1 Installation

Equipment exposed to weather shall be insulated and finished in accordance with the requirements for equipment inside the building. After the above is accomplished, the insulation shall then be further finished as detailed in the following subparagraphs.

Two coats of weather barrier mastic reinforced with fabric or mesh for

outdoor application shall be applied to the entire surface. Each coat of weatherproof mastic shall be 1/16 inch minimum thickness. The exterior shall be a metal jacketing applied for mechanical abuse and weather protection, and secured with screws.

Joints shall be sealed with caulking to prevent moisture penetration. Where jacketing abuts an un-insulated surface, joints shall be sealed with caulking.

3.4.3.2 Optional Panels

At the option of the Contractor, prefabricated metal insulation panels may be used in lieu of the insulation and finish previously specified. Thermal performance shall be equal to or better than that specified for field applied insulation. Panels shall be the standard catalog product of a manufacturer of metal insulation panels. Fastenings, flashing, and support system shall conform to published recommendations of the manufacturer for weatherproof installation and shall prevent moisture from entering the insulation. Panels shall be designed to accommodate thermal expansion and to support a 250 pound walking load without permanent deformation or permanent damage to the insulation. Exterior metal cover sheet shall be aluminum and exposed fastenings shall be stainless steel.

-- End of Section --

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SECTION 23 09 33.00 40

ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

This section covers controls and instrumentation for air handling equipment.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA DC 3	Residential Controls - Electrical Wall-Mounted Room Thermostats

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3	Commercial Blast Cleaning

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-2962	Enamel, Alkyd, Gloss, Low VOC Content
FED-STD-595	Colors Used in Government Procurement

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

The following sections of the SVS Boiler specification apply to work in these sections:

Section 01 33 00 SUBMITTAL PROCEDURES

Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS

Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM

Section 23 00 00 AIR SUPPLY DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS

Section 26 60 13.00 40 LOW -VOLTAGE MOTORS

Submit Material, Equipment, and Fixture Lists for control and instrumentation systems including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

Submit Records of Existing Conditions consisting of the results of survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work constitutes acceptance of existing conditions.

1.3.2 System Requirements

Provide automatic temperature control systems that are complete in all details and that include all necessary accessories to maintain conditions indicated or specified. Refer to drawings A231-1300-M706 HVAC CONTROLS DIAGRAMS, and A231-1300-M602 EQUIPMENT SCHEDULES.

Provide low-voltage electric automatic temperature control systems. As far as practical, provide control equipment that is the product of a single automatic control systems manufacturer. Provide automatic control systems components not the product of the control system manufacturer that are approved for use with the control system as indicated.

Provide automatically controlled valves to control environment that are furnished by the automatic control systems manufacturer.

Provide automatically controlled dampers, independent of dampers integral with manufactured air-handling units, furnished by the automatic control systems manufacturer. Use a damper manufacturer that is licensed to display the Air Movement and Control Association International (AMCA) seal.

Provide dual-duct system mixing boxes and air-mixing valve operators that are furnished by the automatic control systems manufacturer.

Submit Fabrication Drawings for control and instrumentation systems consisting of fabrication and assembly details to be performed in the factory.

Submit Operating Instructions for control and instrumentation consisting of standard operating procedures including startup, shutdown, and emergency operation.

1.4 QUALITY ASSURANCE

1.4.1 Predictive Testing And Inspection Technology Requirements

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance (RCBEA) Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS.

1.4.2 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of similar material, design and workmanship. Provide standard products that have been in satisfactory commercial or industrial use for 2 years prior to bid opening that includes applications of equipment and materials under similar circumstances and of similar size. Provide a product that has been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

1.4.3 Alternative Qualifications

Products having less than a two-year field service record are acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, are shown.

1.4.4 Service Support

Support the equipment items by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. Provide service organizations that are reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of contract.

1.4.5 Manufacturer's Nameplate

Provide each item of equipment with a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent is not acceptable.

1.4.6 Modifications of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, wherever the words shall, should, will, would, or may appear. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the " COR".

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixture Lists for control and instrumentation systems in accordance with paragraph entitled, "General Requirements," of this section.

Submit Records of Existing Conditions in accordance with paragraph entitled, "General Requirements," of this section.

SD-02 Shop Drawings

Submit Fabrication Drawings for control and instrumentation systems in accordance with paragraph entitled, "System Description," of this section.

Submit Installation Drawings in accordance with the paragraph entitled, "Installations," of this section. Include details of equipment room layout and design on the drawings.

SD-03 Product Data

Submit Equipment and performance data for the following items consisting of use life, system functional flows, safety features, and mechanical automated details. Submit curves indicating tested and certified equipment response and performance characteristics.

Control Components

Thermometers

Pressure Gages

Valves

Dampers

Operators

SD-04 Samples

Submit Manufacturer's standard color charts for the following items showing the manufacturer's recommended color and finish selections.

Thermostat Covers

Thermostat Guards

Room Humidistats

SD-06 Test Reports

Submit Test reports for controls and instrumentation systems in accordance with the paragraph entitled, "Field Quality Control,"

of this section.

SD-07 Certificates

Submit Listing of Product Installations for controls and instrumentation systems in accordance with paragraph entitled, "Installation," of this section.

SD-08 Manufacturer's Instructions

Submit Operating Instructions for control and instrumentation in accordance with paragraph entitled, "System Description," of this section.

SD-10 Operation and Maintenance Data

Provide Operation and Maintenance Manuals for the following items:

Air Supply Source

Mechanical Refrigeration-Type Air Dryer

Electric Operators

1.6 STORAGE AND HANDLING

Seal openings after manufacturing and inspection, until ready for installation.

Carefully handle instruments and equipment, do not subject to shock, and protect from weather, dust, construction materials, and damage.

1.7 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

1.8 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Provide motors, controllers, disconnects and contactors that conform to and have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors are not permitted. Provide controllers and contactors that have a maximum of 120 volt control circuits, and have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, include the cost of additional electrical service and related work under the section that specified that motor or equipment. Provide power wiring and conduit for field installed equipment under and conforming to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

PART 2 PRODUCTS

2.1 CONTROL COMPONENTS

2.1.1 Temperature Sensors

Provide temperature sensors, sensor transmitters, and controller output signals that are directly proportional to the variations in the measured variable. Provide linearity that is within plus or minus 1/2 percent for a 200-degree-F span, and plus or minus 1 percent for a 50-degree-F span, throughout the scale range.

Where extremely accurate temperature sensing is required or the transmitter is a considerable distance from the receiver controller, use a two-pipe relay-type transmitter. Provide instrument that has feedback incorporated into the design and 50-degree-F temperature range. Provide capillary that is compensated and is available in 8 and 16-foot averaging lengths. Provide unit that operates on 20 pounds per square inch (psi)input pressure, and has a 3 to 15-psi output over the specified range.

2.1.2 Humidity Sensors

Provide humidity sensors, sensor transmitters, and controller output signals that are directly proportional to the variations in the measured variable. Provide linearity that is within plus or minus 1 percent for a 70 -percent relative humidity span. Provide element that is capable of withstanding 98 percent relative humidity without loss of calibration when humidity sensor is duct-mounted downstream from a cooling coil.

2.1.3 Receiver Controllers

Provide receiver controllers that have a calibrated set point adjustment, minimum calibrated scale with no greater than 2 degrees F divisions for duct and immersion application and 1 degree F divisions for room control application. Provide set point indication and an adjustable proportional band covering the complete range necessary for the specific application. Provide controller range that matches that of the temperature sensor. Provide devices that incorporate authority and remote set point calibrated adjustments, as required.

2.1.4 Receiver Indicators

Provide receiver indicators that have visual readout for temperature and humidity, using the transmitted signal from the sensor device to the receiver-controller device. Provide readout and accuracy of the receiver indicator that has the indicated value within plus or minus 1/2 percent of the span of the measured variable, as transmitted by the sensor. Mark factory calibration on back of instrument. Provide range that matches that of the temperature or humidity sensor.

Provide a combined accuracy of the sensor and the receiver indicator that is within 2 degrees F and 5 percent relative humidity of the span.

Provide ambient conditions to 150 degrees F that do not cause a shift in control point in sensor, receiver controller, or indicator systems.

2.1.5 Space Thermostats

2.1.5.1 Electrical Control

Provide low-voltage type space thermostat with setback/setup temperature control for cooling and heating. Provide thermostat that conforms to NEMA DC 3, and is as indicated.

2.1.5.2 Space Thermostat Accessories

Provide brushed aluminum Thermostat covers.

Provide insulating bases for thermostats located on exterior walls.

Provide cast-metal Thermostat guards in unfinished spaces.

Mount guards and thermostats on separate bases.

2.1.6 Outdoor Reset Thermostat

Provide a remote-bulb type or functionally equivalent bimetallic rod and tube type outdoor reset thermostat for proportioning action with an adjustable throttling range. Provide scale range of 35 to 95 degrees F with adjustable set point over the full range. Mount unit indoors, with sensing bulb mounted outdoors with solar compensation when indicated. Provide unit that proportionally resets the control point of a remote sensing submaster temperature controller.

2.1.7 Immersion Thermostats

Provide remote-bulb type or functionally equivalent bimetallic rod and tube type immersion thermostats, for proportional action with adjustable set point over the full operating range, and adjustable throttling range. Provide a nonferrous separable socket for each thermal element.

When used as a secondary controller, provide a remotely set adjustable set point.

2.1.8 Airstream Thermostats

Provide remote-bulb type or functionally equivalent bimetallic rod and tube type airstream two-position thermostats, with adjustable set point. Provide set point in middle third of range of device.

Provide airstream thermostats for control of modulating devices that are the remote-bulb type for proportional action with adjustable set point over the full operating range, and adjustable throttling range.

Provide airstream thermostats for averaging service that have a remote-bulb element not less than one-half as long as the longest side of the airstream cross section, of a type suitable for averaging service with liquid-filled bulb or equivalent. Gas- or vapor-filled bulbs are not acceptable for averaging service. Locate bulb to sense average temperature.

Provide airstream temperature primary controllers for remote reset or compensating operation, that are remote-bulb type for proportional operation with adjustable set point over the full operating range, adjustable throttling range, and an adjustable authority of the secondary controller. Low- or high-limit thermostats, or other instruments having

one-sided control, are not acceptable where reset or compensating controllers are indicated.

2.1.9 Line-Voltage Thermostats

Provide line-voltage thermostats that have integral "MANUAL ON/OFF/AUTO" selector switch, a maximum differential of 2 degrees F, concealed temperature adjustment, and a locking cover. Provide line-voltage thermostats that are rated for the load, single or two-pole as required.

Provide insulating bases for thermostats located on exterior walls.

Provide cast metal type thermostat guards in unfinished spaces.

Mount guards and thermostats on separate bases, unless otherwise approved.

Provide line-voltage thermostats that are furnished and mounted under this section, and wired in accordance with applicable sections of DIVISION 26 ELECTRICAL unless otherwise specified.

2.1.10 Electrical Low-Limit Duct Thermostat

Provide air-handling unit freeze protection. Make the lowest temperature across any 12 inches of bulb length, single tube, sufficient to trip a snap-acting, single-pole, single-throw switch when the temperature sensed is equal to, or below, set point. Provide 20 square foot minimum length of bulb. Provide one limit thermostat for every 20 square feet of coil surface. Provide thermostats that have manual reset.

2.1.11 Fire Thermostats

Provide fire thermostats that are UL-approved and listed, are factory set in accordance with NFPA 90A, and have normally closed contacts. Perform reset manually.

2.1.12 Heating/Cooling Valve-Top Thermostat

Furnish induction air-conditioning units with valve-top thermostats. Provide units that are proportional acting for proportional flow, remote-bulb liquid-filled element, direct and reverse acting at variable pressures to maximum 25 pounds per square inch, gage (psig) air supply. Provide molded rubber operator diaphragm, die-cast housing, and furnish unit with position indicator and adjusting knob.

2.1.13 Room Humidistats

Provide room humidistats that are wall-mounted, reverse acting, proportioning type, with adjustable minimum throttling range no greater than 2-percent relative humidity. Provide humidistats that are capable of maintaining the relative humidity within the limits of the throttling range for relative humidity of 30 to 80 percent and temperatures to 110 degrees F.

2.1.14 Duct Humidistats

Provide insertion type duct humidistats, mounted on outside of duct, with sensing element within duct. Provide reverse acting, proportioning type duct humidistats, with adjustable minimum-throttling range no greater than 2 percent relative humidity. Provide humidistats capable of maintaining relative humidity within the limits of the throttling range for relative

humidity of 20 to 80 percent and temperatures to 150 degrees F. Provide sensing element suitable for the indicated installation location.

2.1.15 High-Limit Duct Humidistats

Provide insertion type high-limit duct humidistats, mounted on outside of duct, with sensing element within duct. Provide reverse acting, two-position type humidistats, with minimum differential no greater than 2 percent relative humidity. Provide sensing element suitable for the indicated installation location.

2.1.16 Water Temperature Controllers

Insert water temperature controller in a nonferrous separable socket installed in the waterline. Provide controller that operates on an adjustable differential over an adjustable temperature range, and is suitable for operating in conjunction with the control valve provided.

2.1.17 Building Static-Pressure Transmitter

Provide a double-bell, differential type building static-pressure transmitter with temperature compensation. Provide scale range of minus 0.5 to plus 0.5 inch water gage (wg), and sensitivity within plus or minus 0.0005 inch wg. Provide transmitter that transmits an electronic signal to an indicating receiver with a matched scale range.

Provide a total system accuracy of not less than 0.05 inch wg.

2.1.18 Building Static-Pressure Controller

Provide a slack diaphragm type building static-pressure controller, with an adjustable set point, and adjustable throttling range. Provide controller range of 0.01 inch to 6.0 inches wg. Provide throttling range that is adjustable from 0.02 to 0.0 inch wg. Provide electronic output.

Provide a double bell, differential type building static-pressure controller with temperature compensation. Provide scale range of minus 0.5 to plus 0.5 inch wg, and sensitivity within plus or minus 0.05 inch wg. Provide controller with an adjustable set point over the full-scale range and adjustable throttling range, proportional band. Provide electronic output.

2.1.19 Pressure Transmitter

Provide the indicating type pressure transmitters for gas, liquid, or steam service. Provide transmitter range suitable for system operating characteristics. Provide output that is proportional to system pressure. Provide indicating receiver with a matched scale range.

Provide total system accuracy that is not less than 1/2 percent of system range.

2.1.20 Remote Pressure Transmitter

Provide pressure sensors for gas, liquid, or steam service remote indication that are pressure-to-current type. Provide direct current output and power supply that is compatible with the remote readout indicator.

2.1.21 Remote Element Instruments

Provide remote element instruments that have sufficient length of capillary to mount the instrument on the control panel in an accessible location. Provide excess capillary that is coiled and concealed. Provide armored capillary where indicated.

2.1.22 Airflow Switches

Provide UL approved airflow switches, with pressure range of 0.12 to 10 inches wg, and electrical rating of 110 volts ac, 10 ampere and 3/4 horsepower ac pilot duty.

2.1.23 Switches

Provide switches as indicated.

Provide adjustable switches with indicating plates and accessible adjustment. Calibrate and mark minimum-positioning switches that control dampers in percent of maximum airflow determined by airflow test.

2.2 THERMOMETERS

Provide thermometers adjacent to thermostats with nonferrous separable sockets when in immersion service. Select thermometer scale range according to service. Provide thermometers that are readable from operating level.

Provide dial type temperature indicators that have a 5 inch diameter antiparallax dial face with white background and black markings.

Provide maximum-registering type pointer with external calibrator adjustment. Provide accuracy within 1 percent of dial range.

Provide corrosion-resistant steel, bottom-connection type case, with corrosion-resistant steel close-type ring.

Provide stem length that is 1/2 inch fixed thread.

Provide temperature sensor, sensor transmitter, and output signals that are directly proportional to the variations in the measured variable. Provide linearity that is within plus or minus 1/2 percent throughout the scale range for a 200 degree F span, and plus or minus 1 percent for 20 degree F span.

When the transmitter is over 50 feet from the receiver indicator, use a signal booster to improve signal response. Provide a transmitter that has feedback incorporated in the design and has a 70-degree-F temperature range. Provide capillary that is compensated and is available in short style, 8 to 18 foot averaging lengths. Provide unit that operates on a 20 psi input pressure and has a 3 to 15 psi output over the specified range.

For multizone units, provide each zone discharge duct with a remote-reading panel-mounted dial thermometer. Locate sensor not less than 3 feet downstream of the mixing dampers or other device causing air turbulence.

2.3 PRESSURE GAGES

Provide pressure gages used to indicate supply and outlet air pressures of

automatic control instruments that are the manufacturer's standard, minimum 3-1/2 inch diameter.

2.4 CONTROL SYSTEM VALVES

Provide bronze valve bodies, 2 inch iron pipe size (ips) and smaller, with screwed end connections. If 2-1/2 inch ips and larger, provide cast iron valve bodies with flanged end connections.

Provide single seated valves for dead-end service except where otherwise indicated.

Provide modulating service valves with plugs matched to the characteristics of the coil for effective control. Provide tetrafluoroethylene, spring-loaded, and self-adjusting valve-stem packing.

Provide top and bottom guided and AISI, Type 303 corrosion-resistant steel valve stem. Cage construction is acceptable.

Provide valves with position indicators and, where indicated or required for proper operation, provide with positioners.

Provide valve linkage with an adjustment for valve lift.

2.5 POWER-OPERATED DAMPERS

2.5.1 Frame and Blade Assembly

Provide frames and blades that are constructed of extruded aluminum or galvanized steel.

Provide mechanically attached, field replaceable resilient seals. Attachment by adhesive is not acceptable. Provide neoprene jamb seals constructed of aluminum.

Provide frames that have corner reinforcement and stay rods, where necessary. Provide frames that are fabricated by welding or riveting. Repair damaged galvanized surfaces by coating with an equal weight of zinc.

For static pressures in excess of 3 inches wg, provide master-blade-driven dampers with blades longer than 24 inches with a maximum blade width of 8 inches. Provide maximum blade width for other services of 10 inches. Provide 48 inches maximum blade length. For dampers more than 48 inches wide, provide dampers that are made in two or more sections with intermediate mullions; with each section mechanically interlocked with adjoining section or sections.

Provide minimum shaft size of 1/2 inch.

Where linkage is such that operator torque is applied to a master blade and transmitted wherefrom, provide a master blade that is reinforced and a shaft that is full length. This type construction is limited to 2 inch wg, static pressure.

Provide blades that are attached to round shafts by hardened cup-point setscrews, or by being pinned. Provide a minimum three-thread engagement. Where setscrews are used, provide two setscrews, 90 degrees apart, to secure master blade. Secure shaft end retainers by pins or spring washers in grooved shaft or by similar construction.

Calk frames with elastomer compounds to prevent bypass leakage.

Provide blades without resilient seals that have interlocking edges.

2.5.2 Bearings

Provide oil-impregnated sintered bronze or graphite-impregnated nylon sleeve type shaft bearings, except as otherwise indicated. Provide thrust washers at bearings, when necessary to maintain blade alignment.

Provide oil-impregnated sintered bronze or graphite-impregnated nylon linkage pivot bearings.

2.5.3 Installation

Install dampers in accordance with the manufacturer's instructions.

2.6 CONTROL SYSTEM VALVE AND DAMPER OPERATORS

2.6.1 Operators

Provide motor operators that provide smooth proportional control under operating conditions normal to the system.

Provide spring-return operators for two-position control.

Provide spring returns on reversible operators where required for fail-safe operation.

For operators operating in sequence with other operators, provide operators that have adjustable operating ranges and set points.

Provide operators that have sufficient power on closeoff to provide tight sealing against maximum system pressures.

Provide operators that close valves and dampers to fail-safe position indicated.

2.6.2 Dampers

Provide dampers that are equipped with operators of sufficient power to control dampers, without flutter or hunting, through the entire operating range at air velocities at least 20 percent greater than maximum design velocity.

2.6.3 Electric Operators

Provide reversible type electric motor operators for modulating control.

Provide split-phase type electric motor operators with oil-immersed gear train. Provide motor that has ample capacity to handle applied loads under operating conditions normal to the system. Heat locations where temperatures fall below minimum operating temperature of operator.

2.7 CENTRAL CONTROL CABINET

Provide control cabinet that consists of enclosed wall-mounted modular cabinet sections. Provide lockable cabinets with hinged fronts to provide

access to the interior of each cabinet.

2.7.1 Cabinet Construction

Provide cabinets suitably reinforced and braced to provide a flat-faced, rigid-front panel.

Provide surfaces that are free of scale, welding slag, and dirt, and are flat without waves. Do not distort or buckle the cabinet during installation handling.

Provide square cutouts with panels to ensure that instruments are installed level and square.

Make finished cutouts and holes free of burrs and sharp edges. Provide cutouts made up of modular sections in sizes suitable for handling. Provide neat and straight section joints. Securely fasten together and align cabinets, and securely wall or floor anchor each cabinet, as required.

Provide high-grade steel exterior hardware with polished-nickel finish.

Provide cadmium-plated steel interior hardware.

Provide access doors with hinges, latches, and locks. Provide sufficiently sturdy cabinet frames to prevent doors from sagging when open. Provide latches to hold doors open at 90 degrees and provide roller latches to hold doors closed. Furnish keys that are common to all access door locks.

2.7.2 Finish

Clean surfaces in accordance with SSPC SP 6/NACE No.3. Provide blast pattern that has a maximum surface profile of 2.0 mils. Not more than 8 hours after cleaning, follow the manufacturer's standard procedure for priming and finish painting. Conform to CID A-A-2962 or FED-STD-595 for final coat, semi-gloss green enamel for all external surfaces. Use soft gloss white paint for interior surfaces. When painting is not started within 8 hours after cleaning, reclean surfaces before painting.

2.7.3 Graphic System Portrayal

Provide cabinets with individual modules portraying systems configurations. Provide portrayals by approved color-coded graphic tapes in laminated plastic securely fastened to the front panel. Provide beveled edges that are finished smooth and free of waves, scratches, or gouges. Identify instruments and auxiliary equipment by engraved plastic labels. Tape is not acceptable.

2.7.4 Instruments and Components

Obtain approval of instruments prior to installation. Provide clean instruments that are free of foreign matter.

2.7.4.1 Receiver-Type Indicator

Provide receiver-type dial size indicators as indicated.

Provide indicator cases that are made of drawn steel, flush mounted with three equally spaced panel clamps and panel cutout to match indicator as furnished.

Accomplish indicator movement by approved manufacturer's standard practice.

Provide a dial with black numerals and graduating marks on a flat white background.

Provide fixed needle pointer.

Provide indicator calibration by means of calibration screw on face of indicator, with dial accuracy to within 1 degree F in the applicable range.

2.7.4.2 Electronic Temperature Indicator

Provide electronic temperature indicator that indicates the sensor input throughout the operating range of the system. Provide accuracy within plus or minus 1/2 percent of the system range. Provide input that is proportional to the measured variable. Provide scale range of minus 20 to plus 120 degrees F.

2.7.4.3 Electronic Pressure Indicator

Provide electronic pressure indicator, calibrated in inches wg, that indicates the pressure drop through range of transmitter. Provide accuracy of not less than plus or minus 0.05 inch wg.

2.7.4.4 Remote Control Point Adjuster

Provide remote adjustment for resetting the set point of the control device in 2-degree increments for the full range of the control span.

2.7.4.5 Remote Temperature Transmitter

Provide remote temperature transmission of discharge air and space temperature that transmits a signal in proportion to the measured temperature to an electronic thermometer in the central control panel. Provide plus or minus 0.5 degree F total system accuracy.

2.7.4.6 Remote Filter Pressure Transmitter

Provide filter pressure-drop transmitter that transmits an electronic signal to a common pressure indicator, calibrated in inches wg, at the control center. Provide accuracy of not less than plus or minus 0.05 inch wg. Provide pressure transmitter range from 6 inches wg.

2.8 INDIVIDUAL SYSTEM CONTROL PANELS

Provide each air handling system with an individual control panel mounted adjacent to and vibration isolated from the air handling unit.

Provide manufacturer's standard steel construction control panel of adequate gage and sufficient reinforcement to be completely rigid. Provide manufacturer's color finish approved by the COR. Provide mechanically attached, engraved, 1/8 inch thick, laminated, black and white plastic identification plates. Locate panel as indicated.

2.9 FACTORY FINISHING

Manufacturer's standard factory finishing systems is acceptable with certification that the factory painting system applied withstands 125 hours

in a salt-spray fog test, and equipment located outdoors withstands 500 hours in salt-spray fog test. Perform salt-spray fog test in accordance with ASTM B 117, and for that test the acceptance criteria are the following: immediately after completion of the test, the paint shows no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shows no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

Provide a film thickness of not less than the film thickness used on the test specimen for the factory finishing system applied on the equipment . If manufacturer's standard factory finishing system is being proposed for use on surfaces subject to temperatures above 120 degrees F (50 degrees C), provide a factory finishing system designed for the temperature service.

PART 3 EXECUTION

3.1 INSTALLATION

Install control components using Contractor-certified control and instrumentation specialists.

Install in accordance with the manufacturer's instructions and as indicated.

Submit Installation Drawings and include details of equipment room layout and design.

3.2 MECHANICAL REFRIGERATION AIR DRYER INSTALLATION

Wall mount through rubber-in-shear mounts. Connect dryer to air compressor outlet with pressure regulator installed downstream of dryer.

3.3 VIBRATION ISOLATION

To prevent vibration, isolate controllers by location or by mounting devices supplied by the equipment manufacturer.

Install tubing and conduit to prevent the transmission of equipment vibration. Mount single tube runs in aircraft-type clamps containing an elastomer insert, preventing contact with ducting or air handling unit housing, casing, or enclosure. Provide multiple runs that conform to the same isolation requirements, but submit mounting details for approval. Refer to Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT for vibration isolation considerations.

3.4 FIELD QUALITY CONTROL

Perform PT&I tests and provide submittals as specified in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS.

Perform Test reports in accordance with referenced standards in this section.

Test multizone unit dampers for temperature pickup due to leakage when hot deck is closed and cold deck is open. Provide 2 degrees F maximum temperature rise when the temperature difference between the hot and cold decks is 20 degrees F, unless otherwise approved.

After the inspection has been completed, check systems for continuity.

After completion of control and instrument installation, test and adjust control equipment in terms of design, function, systems balance, and performance, and otherwise make ready for air handling systems acceptance tests. Provide data showing set points and final adjustments of controls.

After air handling system acceptance and after the systems have operated in normal service for 2 weeks, check the adjustment on instruments and devices. Correct items found to be out of order. When air handling systems are in specified operating condition and when all other pertinent specifications requirements have been met, automatic temperature-control systems are acceptable.

Provide equipment to check the calibration of instruments. Recalibrate or replace instruments not in calibration.

3.5 OPERATOR TRAINING

Provide written operating instructions and not less than 8 hours of operator training.

Provide classroom and field instructions in operation and maintenance of systems equipment where required by the technical provisions. Direct these services using the manufacturer's factory trained personnel or qualified representative. Give the COR seven calendar days written notice of scheduled instructional services. Make instructional materials belonging to the manufacturer or vendor available to the COR.

3.6 SPECIAL TOOLS

Provide special tools as required for the operation and adjustment of controllers, instruments, or other control system devices.

3.7 OPERATION AND MAINTENANCE

Provide Operation and Maintenance Manuals that are consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions.

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FACILITY GAS PIPING

PART 1 GENERAL

1.1 SUMMARY

This section covers low pressure facility gas piping systems conforming to NFPA 54/ANSI Z223.14 for non-industrial uses.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.15/CSA 9.1	Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves
ANSI Z21.18/CSA 6.3	Gas Appliance Pressure Regulators
ANSI Z21.80/CSA 6.22	Line Pressure Regulators

AMERICAN PETROLEUM INSTITUTE (API)

API RP 1110	Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids or Carbon Dioxide
API RP 2009	Safe Welding, Cutting, and Hot Work Practices in Refineries, Gasoline Plants, and Petrochemical Plants
API Spec 6D	Specification for Pipeline Valves
API Std 598	Valve Inspecting and Testing
API Std 607	Testing of Valves: Fire Test for Soft-Seated Quarter-Turn Valves

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 25-06	Earthquake-Activated Automatic Gas Shutoff Devices

ASME INTERNATIONAL (ASME)

ASME A13.1	Scheme for the Identification of Piping Systems
ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ASME B16.1	Gray Iron Threaded Fittings; Classes 25, 125 and 250
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.3	Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.33	Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psi, Sizes NPS 1/2 - NPS 2
ASME B16.39	Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.9	Building Services Piping
ASME B36.10M	Standard for Welded and Seamless Wrought Steel Pipe
ASME B40.100	Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	BPVC Section IX-Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A105/A105M	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A181/A181M	Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM F 2015	Standard Specification for Lap Joint Flange Pipe End Applications

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	National Fuel Gas Code
NFPA 70	National Electrical Code

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1650	Seismic Restraint Manual Guidelines for Mechanical Systems, 2nd Edition

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3	Commercial Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL Gas&Oil Dir	Flammable and Combustible Liquids and Gases Equipment Directory

1.3 SYSTEM DESCRIPTION

The gas piping system includes natural gas piping and appurtenances from point of connection with supply system, as indicated, to gas operated equipment within the facility. Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, in three separate packages. Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS applies to this section, with additions and modifications specified herein.

1.3.1 Gas Facility System and Equipment Operation

Include shop drawings showing piping layout, locations of system valves, gas line markers; step-by-step procedures for system start up, operation and shutdown (index system components and equipment to the system drawings); isolation procedures including valve operation to shutdown or isolate each section of the system (index valves to the system maps and provide separate procedures for normal operation and emergency shutdown if required to be different). Submit Data package No. 4.

1.3.2 Gas Facility System Maintenance

Include maintenance procedures and frequency for system and equipment; identification of pipe materials and manufacturer by locations, pipe repair

procedures, and jointing procedures at transitions to other piping material or material from a different manufacturer. Submit Data Package No.4.

1.3.3 Gas Facility Equipment Maintenance

Include identification of valves, shut-offs, disconnects, and other equipment by materials, manufacturer, vendor identification and location; maintenance procedures and recommended tool kits for valves and equipment; recommended repair methods (i.e., field repair, factory repair, or replacement) for each valve and piece of equipment; and preventive maintenance procedures, possible failure modes and troubleshooting guide. Submit Data Package No. 3.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Gas Piping System

SD-03 Product Data

Pipe and Fittings
Gas equipment connectors

Gas Piping System
Pipe Coating Materials
Pressure regulators
Valves

SD-06 Test Reports

Testing
Pressure Tests

Test With Gas

SD-07 Certificates

Welders procedures and qualifications
Welders assigned number, letter, or symbol

SD-08 Manufacturer's Instructions

Pipe coating materials

SD-10 Operation and Maintenance Data

Gas facility system and equipment operation
Gas facility system maintenance
Gas facility equipment maintenance

1.5 QUALITY ASSURANCE

Submit manufacturer's descriptive data and installation instructions for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Mark all valves, flanges and fittings

in accordance with MSS SP-25.

1.5.1 Welding Qualifications

a. Weld piping in accordance with qualified procedures using performance qualified welders and welding operators in accordance with API RP 2009, ASME BPVC SEC IX, and ASME B31.9. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.9. Notify the COR at least 24 hours in advance of tests, and perform at the work site if practicable.

b. Submit a certified copy of welders procedures and qualifications metal in conformance with ASME B31.9 for each welder and welding operator. Submit the assigned number, letter, or symbol that will be used in identifying the work of each welder to the COR.

1.5.2 Shop Drawings

Submit drawings for complete Gas Piping System, within 30 days of contract award, showing location, size and all branches of pipeline; location of all required shutoff valves; and instructions necessary for the installation of gas equipment connectors and supports.

1.6 DELIVERY, STORAGE, AND HANDLING

Handle, transport, and store pipe and fittings carefully. Plug or cap pipe and fittings ends during transportation or storage to minimize dirt and moisture entry. Do not subject piping to abrasion or concentrated external loads. Discard pipe sections and fittings that have been damaged.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos are not allowed. Submit catalog data and installation instructions for pipe, valves, all related system components, pipe coating materials and application procedures. Conform to NFPA 54 and with requirements specified herein. Provide supply piping to appliances or equipment at least as large as the inlets thereof.

2.2 GAS PIPING SYSTEM AND FITTINGS

2.2.1 Steel Pipe, Joints, and Fittings

a. Pipe: Black carbon steel in accordance with ASTM A53/A53M, Schedule 40, threaded ends for sizes 2 inches and smaller; otherwise, Schedule 40 plain end beveled for butt welding.

b. Threaded Fittings: ASME B16.3, black malleable iron.

c. Socket-Welding Fittings: ASME B16.11, forged steel.

d. Butt-Welding Fittings: ASME B16.9, with backing rings of compatible material.

e. Unions: ASME B16.39, black malleable iron.

f. Flanges and Flanged Fittings: ASME B16.5 steel flanges or convoluted steel flanges conforming to ASME BPVC SEC VIII D1, with flange faces having integral grooves of rectangular cross sections which afford containment for self-energizing gasket material.

Provide steel pipe conforming to ASME B36.10M; and malleable-iron threaded fittings conforming to ASME B16.1 and ASME B16.3. Provide steel pipe flanges and flanged fittings, including bolts, nuts, and bolt pattern in accordance with ASME B16.5 and ASTM A105/A105M. Provide wrought steel buttwelding fittings conforming to ASME B16.9. Provide socket welding and threaded forged steel fittings conforming to ASME B16.11 and ASTM A181/A181M, Class 60.

2.2.2 Sealants for Steel Pipe Threaded Joints

Provide joint sealing compound as listed in UL Gas&Oil Dir, Class 20 or less. For taping, use tetrafluoroethylene tape conforming to UL Gas&Oil Dir.

2.2.3 Warning and Identification

Provide pipe flow markings, warning and identification tape, and metal tags as required.

2.2.4 Flange Gaskets

Provide gaskets of nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type, containing aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR) suitable for a maximum 600 degree F service, to be used for hydrocarbon service.

2.2.5 Pipe Threads

Provide pipe threads conforming to ASME B1.20.1.

2.2.6 Escutcheons

Provide chromium-plated steel or chromium-plated brass escutcheons, either one piece or split pattern, held in place by internal spring tension or set screw.

2.2.7 Insulating Pipe Joints

2.2.7.1 Insulating Joint Material

Provide insulating joint material between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

2.2.7.2 Threaded Pipe Joints

Provide threaded pipe joints of steel body nut type dielectric unions with insulating gaskets.

2.2.7.3 Flanged Pipe Joints

Provide joints for flanged pipe consisting of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for

flange bolts, and insulating washers for flange nuts. Provide lap joint flange pipe ends conforming to ASTM F 2015.

2.2.8 Flexible Connectors

a. Provide flexible connectors for connecting gas utilization equipment to building gas piping conforming to ANSI Z21.24/CSA 6.10.

b. Do not install the flexible connector through the appliance cabinet face. Provide rigid metallic pipe and fittings to extend the final connection beyond the cabinet, except when appliance is provided with an external connection point.

2.3 VALVES

Provide AGA approved lockable shutoff or service isolation valves as indicated in the drawings conforming to the following:

2.3.1 Valves 2 Inches and Smaller

Provide valves 2 inches and smaller conforming to ASME B16.33 of materials and manufacture compatible with system materials used.

2.3.2 Valves 2-1/2 Inches and Larger

Provide valves 2-1/2 inches and larger of carbon steel conforming to API Spec 6D, Class 150. Provide gear operators on gas valves larger than 6 inches.

2.4 PIPE HANGERS AND SUPPORTS

Provide pipe hangers and supports conforming to MSS SP-58 and MSS SP-69.

2.5 REGULATORS AND SHUTOFF VALVES

Provide pressure gauges and attachments conforming to ASME B40.100. Provide regulators conforming to ANSI Z21.18/CSA 6.3 for appliances, and ANSI Z21.80/CSA 6.22 for line pressure regulators. Provide shutoff valves conforming to ANSI Z21.15/CSA 9.1 for manually controlled gas shutoff valves.

2.6 SEISMIC PROVISIONS

Provide earthquake automatic gas shutoff valve conforming to ASCE 25-06, SMACNA 1650, and UL listed or AGA listed or International Association of Plumbing and Mechanical Officials (IAPMO) listed. The valve may be either pendulum or ball construction with actuator.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the COR of any discrepancy or areas of conflict before performing the work.

3.2 GAS PIPING SYSTEM

Provide a gas piping system from the point of delivery, defined as the outlet of the shutoff valve, to the connections to each gas utilization

device.

3.2.1 Protection and Cleaning of Materials and Components

Protect equipment, pipe, and tube openings by closing with caps or plugs during installation. At the completion of all work, thoroughly clean the entire system.

3.2.2 Workmanship and Defects

Piping, tubing and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and chip-and scale-blown. Repair of defects in piping, tubing or fittings is not allowed; replace defective items when found.

3.3 PROTECTIVE COVERING

3.3.1 Aboveground Metallic Piping Systems

3.3.1.1 Ferrous Surfaces

Touch up shop primed surfaces with ferrous metal primer. Solvent clean surfaces that have not been shop primed. Mechanically clean surfaces that contain loose rust, loose mill scale and other foreign substances commercial sand blasted conforming to SSPC SP 6/NACE No.3 and prime with ferrous metal primer. Finish primed surfaces with two coats of exterior oil paint or vinyl paint.

3.4 INSTALLATION

Install the gas system in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54 and as indicated. Perform all pipe cutting without damage to the pipe, with an approved type of mechanical cutter, unless otherwise authorized. Use wheel cutters where practicable. On steel pipe 6 inches and larger, an approved gas cutting and beveling machine may be used.

3.4.1 Metallic Piping Installation

Make changes in direction of piping with long radius fittings only; mitering or notching pipe to form elbows and tees or other similar type construction is not permitted. Branch connection may be made with either tees or forged branch outlet fittings. Provide branch outlet fittings which are forged, flared for improvement of flow where attached to the run, and reinforced against external strains.

3.4.2 Aboveground Piping

Run aboveground piping as straight as practicable along the alignment and elevation indicated, with a minimum of joints, and separately supported from other piping system and equipment. Install exposed horizontal piping no farther than 6 inches from nearest parallel wall and at an elevation which prevents standing, sitting, or placement of objects on the piping.

3.4.3 Final Gas Connections

Unless otherwise specified, make final connections with rigid metallic pipe and fittings. Flexible connectors may be used for final connections to auxiliary boiler. In addition to cautions listed in instructions required

by ANSI standards for flexible connectors, insure that flexible connectors do not pass through equipment cabinet. Provide accessible gas shutoff valve and coupling for each gas equipment item.

3.4.4 Seismic Requirements

Support and brace piping and attached valves to resist seismic loads in conformance with ASCE 25-06 and as shown on the drawings.

3.5 PIPE JOINTS

Design and install pipe joints to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.

3.5.1 Threaded Metallic Joints

Provide threaded joints in metallic pipe with tapered threads evenly cut and made with UL approved graphite joint sealing compound for gas service or tetrafluoroethylene tape applied to the male threads only. Threaded joints up to 1-1/2 inches in diameter may be made with approved tetrafluoroethylene tape. Threaded joints up to 2 inches in diameter may be made with approved joint sealing compound. After cutting and before threading, ream pipe and remove all burrs. Caulking of threaded joints to stop or prevent leaks is not permitted.

3.5.2 Welded Metallic Joints

Conform beveling, alignment, heat treatment, and inspection of welds to NFPA 54. Remove weld defects and make repairs to the weld, or remove the weld joints entirely and reweld. After filler metal has been removed from its original package, protect and store so that its characteristics or welding properties are not affected adversely. Do not use electrodes that have been wetted or have lost any of their coating.

3.6 SPECIAL REQUIREMENTS

Provide drips, grading of the lines, freeze protection, and branch outlet locations as shown and conforming to the requirements of NFPA 54.

3.7 BUILDING STRUCTURE

Do not weaken any building structure by the installation of any gas piping. Do not cut or notch beams, joists or columns. Attach piping supports to metal decking. Do not attach supports to the underside of concrete filled floors or concrete roof decks unless approved by the COR.

3.8 PIPING SYSTEM SUPPORTS

Support gas piping systems in buildings with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping or tubing. Do not support any gas piping system by other piping. Conform spacing of supports in gas piping and tubing installations to the requirements of NFPA 54. Conform the selection and application of supports in gas piping and tubing installations to the requirements of MSS SP-69.

3.9 ELECTRICAL BONDING AND GROUNDING

Provide a gas piping system within the building which is electrically continuous and bonded to a grounding electrode as required by NFPA 70.

3.10 SHUTOFF VALVE

Install the main gas shutoff valve controlling the gas piping system to be easily accessible for operation, as indicated, protected from physical damage, and marked with a metal tag to clearly identify the piping system controlled.

3.11 TESTING

Submit test reports in booklet form tabulating test and measurements performed; dated after award of this contract, and stating the Contractor's name and address, the project name and location, and a list of the specific requirements which are being certified. Test entire gas piping system to ensure that it is gastight prior to putting into service. Prior to testing, blow out the system, clean, and clear all foreign material. Test each joint with an approved gas detector, soap and water, or an equivalent nonflammable solution. Inspect and test each valve in conformance with API Std 598 and API Std 607. Complete testing before any work is covered, enclosed, or concealed, and perform with due regard for the safety of employees and the public during the test. Install bulkheads, anchorage and bracing suitably designed to resist test pressures if necessary, and as directed and or approved by the COR. Do not use oxygen as a testing medium.

3.11.1 Pressure Tests

Submit test reports in booklet form tabulating test and measurements performed; dated after award of this contract, and stating the Contractor's name and address, the project name and location, and a list of the specific requirements which are being certified. Before appliances are connected, test by filling the piping systems with air or an inert gas to withstand a minimum pressure of 38 pounds gauge for a period of not less than 30 minutes as specified in NFPA 54 without showing any drop in pressure. Do not use Oxygen for test. Measure pressure with a mercury manometer, slope gauge, or an equivalent device calibrated to be read in increments of not greater than 0.1 pound. Isolate the source of pressure before the pressure tests are made.

3.11.2 Test With Gas

Before turning on gas under pressure into any piping, close all openings from which gas can escape. Immediately after turning on the gas, check the piping system for leakage by using a laboratory-certified gas meter, an appliance orifice, a manometer, or equivalent device. Conform all testing to the requirements of NFPA 54. If leakage is recorded, shut off the gas supply, repair the leak , and repeat the tests until all leaks have been stopped.

3.11.3 Purging

After testing is completed, and before connecting any appliances, fully purge all gas piping. Conform testing procedures to API RP 1110. Do not purge piping into the combustion chamber of an appliance. Do not purge the open end of piping systems into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA 54 are followed.

3.11.4 Labor, Materials and Equipment

Furnish all labor, materials and equipment necessary for conducting the testing and purging.

3.12 PIPE COLOR CODE MARKING

Provide color code marking of piping as specified in Section 09 90 00 PAINTS AND COATINGS, conforming to ASME A13.1.

-- End of Section --

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SECTION 23 25 00

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3.5.2.1 Steam Boiler Water Quality Assurance Tests
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3.6.1 Inspection General Requirements
3.6.2 Boiler/Piping Test

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SECTION 23 25 00

CHEMICAL TREATMENT OF WATER FOR MECHANICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

This section covers chemical treatment of water for mechanical systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASME INTERNATIONAL (ASME)

ASME B40.100	Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM D 2688	Corrosivity of Water in the Absence of Heat Transfer (Weight Loss Methods)
ASTM D 596	Reporting Results of Analysis of Water

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	Motors and Generators

U.S. ARMY CORPS OF ENGINEERS (USACE)

PWTB 420-49-5	Industrial Water Treatment Procedures

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-230-08A	Water Supply: Water Treatment

1.3 SYSTEM DESCRIPTION

This section covers the provisions and installation procedures necessary for a complete and totally functional water system(s) chemical treatment. Provide and install the system with all necessary System Components, Accessories, Piping Components, and Supplemental Components/Services.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Water Treatment System

Water Analysis

Six complete copies, at least 5 weeks prior to the purchase of the water treatment system, of the proposed water treatment plan including a layout; control scheme; a list of existing make-up water chemistry, including the items listed in paragraph Water Analysis; a list of treatment chemicals to be added; the proportion of chemicals to be added; the final treated water control levels; and a description of health, safety and environmental concerns for handling the chemicals plus any special ventilation requirements.

Spare Parts

Spare parts data for each different item of material and equipment specified.

Field Instructions

Instructions, at least 2 weeks prior to construction completion, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions shall be framed under glass or laminated plastic and posted where indicated by the COR.

Tests

Test schedules, at least 2 weeks prior to the start of related testing, for the condenser/chilled/boiler/condensate/feedwater water quality tests. The schedules shall identify the date, time, frequency and collection location for each test.

Demonstrations

A schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

SD-06 Test Reports

Steam Boiler Water Quality Assurance Tests

The water quality test report identifying the chemical composition of the boiler and feedwater water. The report shall include a comparison of the condition of the boiler water with the manufacturer's or chemical vendor's recommended conditions. Any required corrective action shall be documented within the report.

SD-10 Operation and Maintenance Data

Water Treatment System

Six complete copies of operating and maintenance manuals for the step-by-step water treatment procedures. The manuals shall include testing procedures used in determining water quality.

1.5 QUALITY ASSURANCE

1.5.1 Safety

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Install safety devices so that proper operation of equipment is not impaired.

1.5.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.7 MAINTENANCE

Submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings, not later than 1 month prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with source of supply

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

a. Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacturing of such products, that are of a similar material, design and workmanship and that have been in satisfactory commercial or industrial use for two years prior to bid opening.

b. The two-year use shall include applications of equipment and materials under similar circumstances and of similar size. The two years experience shall have been satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown.

c. All products shall be supported by a service organization. Submit a certified list of qualified permanent service organizations for support of the equipment, including their addresses and qualifications. These

service organizations shall be reasonably convenient to the equipment installation and shall be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

d. The selected service organization shall provide the chemicals required, the concentrations required, and the water treatment equipment sizes and flow rates required. The chemical shall meet the requirements of this specification as well as the recommendations from the manufacturers of the condenser and cooling tower. Acid treatment chemicals shall not be used.

2.2 NAMEPLATES

Each major component of equipment shall have the manufacturer's name, address, type or style, and catalog or serial number on a plate securely attached to the item of equipment. Nameplates shall be provided for:

a. Pump(s)

b. Pump Motor(s)

2.3 ELECTRICAL WORK

Electrical equipment, motors, motor efficiencies, and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide electrical motor driven equipment specified complete with motors, motor starters, and controls. Electrical characteristics and enclosure type shall be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, or totally enclosed fan cooled enclosures, shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. All motors shall be continuous duty with the enclosure specified. Provide motor starters complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Furnish motors with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor starter shall be provided with NEMA 3 enclosures. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

2.4 GAUGES

Gauges shall conform to ASME B40.100, Class 1, 2, or 3, Style X, Type I or III as required, 4-1/2 inches in diameter with phenolic or metal case.

2.5 WATER ANALYSIS

Conditions of make-up water to be supplied to the boilers, reported in accordance with ASTM D 596 are as follows:

Total Hardness: 0.200 ppm $CaCO_3$ Nalco TF-10, Table 1: 451 to 600 psig
Total Dissolved Solids (TDS): 850 ppm HPAC 9/99
Iron: .030 ppm Fe Nalco TF-10, Table 1: 451 to 600 psig
Iron: 0 to 1 ppm HPAC 9/99
Copper: .020 ppm Cu Nalco TF-10, Table 1: 451 to 600 psig
Silica: 0 to 5.5 ppm SiO_2

pH: 9 to 9.5 HPAC 9/99
Sulfate: 0 to 50 ppm HPAC 9/99
Total alkalinity: 150 to 400 ppm HPAC 9/99
Carbon dioxide: 0 ppm HPAC 9/99
Oxygen: 7 ppm HPAC 9/99
Temperature: >/-180°F HPAC 9/99
Use catalyzed sulfite for rapid oxygen scavenging
Condensate TDS: Assume 5 ppm HPAC 11/85
Sulfite: Distribute 6" to 12" below NOWL BSE 1/10
Sulfite residual: 25 to 40 ppm BSE 1/10 HPAC 9/99

2.6 STEAM BOILER WATER TREATMENT

Provide a water treatment system capable of feeding chemicals and blowdown of the system to prevent corrosion and scale within the boiler and piping distribution system. Treat the water to maintain the conditions recommended by the boiler manufacturer or UFC 3-230-08A (Central Boiler Plants) and PWTB 420-49-5 (Industrial Water Treatment Procedures). Chemicals shall meet required federal, state, and local environmental regulations for the treatment of boilers and discharge to the sanitary sewer. The services of a company regularly engaged in the treatment of boilers shall be used to determine the correct concentrations required for water treatment. The company shall maintain the chemical treatment and provide all chemicals required for a period of 1 year from the date of occupancy. Filming amines, hydrazine and chelants shall not be used. The water treatment chemicals shall remain stable throughout the operating temperature range of the system and shall be compatible with pump seals and other elements of the system.

2.6.1 Boiler Water Limits

The boiler water limits shall be as follows unless dictated differently by the boiler manufacturer's recommendations:

Total Dissolved Solids (TDS): 2,500 ppm HPAC 10/99, Table 1: 351 to 500 psig
Total Dissolved Solids (TDS): 3,000 ppm K-Master, Table 1: 301 to 450 psig C-B
Total Dissolved Solids (TDS): 3,000 ppm HPAC 11/85, Table 1: 301 to 450 psig
Total Suspended Solids: 10 ppm HPAC 10/99, Table 1: 351 to 500 psig
Total Suspended Solids: 250 ppm C-B: 301 to 450 psig
Total Hardness: 2,500 mhos Nalco TF-10, Table 1: 451 to 600 psig
Iron: 5 ppm Fe HPAC 10/99, Table 1: 351 to 500 psig
Silica: 40 ppm SiO_2 alco TF-10, Table 1: 451 to 600 psi
Silica: 50 ppm DiO_2 HPAC 10/99, Table 1: 351 to 500 psig
Total Alkalinity: 250 ppm $CaCO_3$ Nalco TF-10, Table 1: 451 to 600 psig
Total Alkalinity: 600 ppm $CaCO_3$ K-Master, Table 1: 301 to 450 psig C-B
Total Alkalinity: 600 ppm $CaCO_3$ HPAC 11/85, Table 1: 301 to 450 psig

Use ABMA or chemical vendor recommended limits above 300 psi.

2.6.2 Water Softening System

The water softening system shall be as specified in Section 22 31 00 WATER SOFTENERS, CATION-EXCHANGE (SODIUM CYCLE).

2.6.3 Boiler Water Treatment System

The water treatment system shall be capable of automatically feeding chemicals to prevent corrosion and scale within the boiler and condensate system. Automatic chemical feed systems shall feed chemicals into the boiler based on makeup water rate. Electrical signals from a water meter on the makeup water line shall be used to control the output of chemical feed pumps.

2.6.4 Steam Boiler Chemical Feed Pumps and Tanks

a. Furnish chemical feed pumps and tanks as a package with the pumps mounted on and piping connected to the tank. The chemical feed pumps shall be positive displacement diaphragm type. The pump cylinders, plungers, ball check valves, and check valve bodies shall be of corrosion resistant materials suitable for the chemicals being pumped. Cylinders shall be replaceable for increased or reduced pressure or capacity ranges. The flow rate of the pumps shall be adjustable from 0 to 100 percent while in operation. Volumetric accuracy of the pumps shall be within one percent over the range indicated. Pump capacities shall be adjustable by positioning crank pin with micrometer setscrews. Stroke length scale shall be divided in percentage graduations engraved on scale.

b. The discharge pressure of pumps shall not be less than 1.5 times the line pressure at the point of connection. The pumps shall be provided with a pressure relief valve and a check valve mounted in the pump discharge. The pumps shall be controlled by an external controller/timer receiving signals from the makeup water meter. Drive motors shall be 110 volt, single phase and shall have drip-proof enclosures.

c. The tanks shall be constructed of high density polyethylene with a hinged cover and mounted on legs. Tanks shall have filling and drain connections and gauge glass. Each tank shall be furnished with one pump, mounted and piped with black iron pipe and fittings, with suction strainer and stainless steel screen, and with 1/2 inch relief valve with steel body and stainless steel trim. Tank bottom shall be dished concave to a radius equal to the diameter of the tank. The tank for sodium sulfite will have a floating cover to minimize contact with air. Motor-driven agitator shall be provided. The tanks shall have sufficient capacity to require recharging only once per 7 days during normal operation.

2.6.5 Steam Boiler Chemical Injection Assemblies

Provide an injection assembly at each chemical injection point located along the boiler piping as indicated. The injection assemblies shall be constructed of stainless steel. The discharge of the assemblies shall extend to the centerline of the piping. Each assembly shall include a shutoff valve and check valve at the point of entrance into the water line.

2.6.6 Steam Boiler Water Meter

Provide the water meter with an electric contacting register and remote accumulative counter. Install the meter within the makeup water line, as indicated.

2.6.7 Steam Boiler Timers

Timers shall be of the automatic reset, adjustable type, and electrically operated. The timers shall be designed to work with the contacting head water meters. The timer should include the water meter cable. The timers will control operation of the chemical feed pumps. The timers shall be suitable for a 120 volt current. The timers shall be used to control the electrical signals from the water meters to the chemical feed pumps.

2.6.8 Steam Boiler Control Panel

The panel shall contain, as a minimum, the following functions identified with a laminated plastic nameplate:

a. Main power switch and indicating light

b. MAN-OFF-AUTO selector switch

c. Indicating lamp for each chemical feed pump

d. Indicating lamp for the water softener

2.6.9 Boiler Blowdown

Provide the boiler with automatic blowdown based upon conductivity or boiler load. Bottom blowdown connection and valve shall also be present to allow removal of solids and water from the bottom of the boiler.

2.6.10 Boiler Chemical Piping

The piping and fittings shall be constructed of stainless steel.

2.6.11 Boiler Test Kits

One test kit of each type required to determine the water quality as outlined in paragraph Boiler Water Limits above and within the operation and maintenance manuals.

2.7 SUPPLEMENTAL COMPONENTS/SERVICES

Drain and makeup water piping shall comply with the requirements of Section 22 00 00 PLUMBING, GENERAL PURPOSE. Drains which connect to sanitary sewer systems shall be connected by means of an indirect waste.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the COR of any discrepancy, before performing any work.

3.2 INSTALLATION

Provide all chemicals, equipment and labor necessary to bring all system waters in conformance with the specified requirements. Perform all work in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements.

3.3 PIPING

Connections between dissimilar metals shall be made with a dielectric union.

3.4 TRAINING COURSE

Conduct a training course for the operating staff as designated by the COR. The training period shall consist of a total 20 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations.

3.5 TESTS

If the waters of the mechanical systems are not in conformance with the specified requirements or in accordance with manufacturer's recommendations, the water treatment company shall take corrective action to enable compliance. Daily operational tests shall be performed in the directed frequencies to maintain required control to prevent corrosion, scaling and damage to equipment during operation

3.5.1 Steam Boiler Water Testing

3.5.1.1 Large Steam Systems (daily)

Daily, for steam boiler systems operating above 15 psi and 100 hp, the following items will be recorded and utilized for operational purposes.

Sulfite ($NaSO_3$)	_____ ppm (mg/L)
P Alkalinity (as $CaCO_3$)	_____ ppm (mg/L)
Conductivity	_____ micromho/cm
Neutralized Conductivity	_____ micromho/cm
Total Dissolved Solids	_____ ppm (mg/L)
Phosphate (PO_4)	_____ ppm (mg/L)
Condensate pH	_____
Condensate Conductivity	_____ micromho/cm
Condensate Hardness (as $CaCO_3$)	_____ ppm (mg/L)
Makeup Water Hardness (as $CaCO_3$)	_____ ppm (mg/L)

3.5.2 Quality Assurance Testing

Conduct quality assurance testing periodically by an independent water treatment lab/consultant to verify to managers that the mechanical and water treatment systems are being maintained properly. Provide the Quality Assurance evaluation reports to the government COR.

3.5.2.1 Steam Boiler Water Quality Assurance Tests

a. Large steam boilers are those operating above 15 psi and 100 hp. The boiler water shall be analyzed a minimum of once a month for a period of 1 year by an independent consultant. The analysis shall include the following information recorded in accordance with ASTM D 596.

Date of Sample	_____
pH	_____ su
Sulfite ($NaSO_3$)	_____ ppm (mg/L)
P Alkalinity (as $CaCO_3$)	_____ ppm (mg/L)
Conductivity	_____ micromho/cm

Neutralized Conductivity	_____	micromho/cm
Total Dissolved Solids	_____	ppm (mg/L)
Phosphate (PO4)	_____	ppm (mg/L)
Polymer	_____	ppm (mg/L)
Silica (SiO2)	_____	ppm (mg/L)
Iron (total, as Fe(2)O(3))	_____	ppm (mg/L)
Condensate pH	_____	
Condensate Conductivity	_____	micromho/cm
Condensate Hardness (as CaCO3)	_____	ppm (mg/L)
Condensate Iron (total, as Fe(2)O(3))	_____	ppm (mg/L)
Makeup Water Hardness (as CaCO3)	_____	ppm (mg/L)
Written evaluation summary		

3.5.3 Corrosion Testers

Install corrosion coupon and rack systems to verify corrosion control in the systems. Testers or coupons are installed in flowing system water through a sidestream or rack system. Both mild steel and copper metal samples are to be tested in the corrosion testers in accordance with ASTM D 2688. Samples are to be replaced and analyzed every 3 months. Rates of corrosion less than 3 mpy for steel and 0.2 mpy for copper are acceptable. Corrosion testers shall be installed on the piping systems of the following systems.

Hot water loop

3.6 INSPECTIONS

3.6.1 Inspection General Requirements

Thirty days after project completion, inspect the cooling tower and condenser for problems due to corrosion, scale, and biological growth. If the cooling tower and condenser are found not to conform to the manufacturer's recommended conditions, and the water treatment company recommendations have been followed; the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations.

3.6.2 Boiler/Piping Test

Thirty day after project completion, inspect the boiler and condensate piping for problems due to corrosion and scale. If the boiler is found not to conform to the manufacturer's recommendations, and the water treatment company recommendations have been followed, the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations.

-- End of Section --

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SECTION 23 52 33.03 20

STEAM BOILER SYSTEM

PART 1 GENERAL

1.1 SUMMARY

This section covers steam heating plants from 2 1/2 to 47 1/4 kg/sec 20,000 to 375,000 lbs/hr of steam capacity using packaged watertube boilers which burn either oil or gas or both fuels combined.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN BOILER MANUFACTURERS ASSOCIATION (ABMA)

ABMA Boiler 103	Selected Codes and Standards of the Boiler Industry

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

ANSI/AISC 360	Specification for Structural Steel Buildings

AMERICAN LADDER INSTITUTE (ALI/LADDER)

ALI/LADDER A14.3	Standard for Fixed Ladders and Safety Requirements

AMERICAN PETROLEUM INSTITUTE (API)

API Std 607	Testing of Valves: Fire Test for Soft-Seated Quarter-Turn Valves

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C651	Standard for Disinfecting Water Mains

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel
AWS D1.3/D1.3M	Structural Welding Code - Sheet Steel

ASME INTERNATIONAL (ASME)

ASME A13.1	Scheme for the Identification of Piping Systems
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.34	Valves - Flanged, Threaded and Welding End
ASME B16.39	Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	Power Piping
ASME B31.9	Building Services Piping
ASME BPVC SEC I	BPVC Section I-Rules for Construction of Power Boilers
ASME BPVC SEC II-C	BPVC Section II-Materials Part C-Specifications for Welding Rods Electrodes and Filler Metals
ASME BPVC SEC VII	BPVC Section VII-Recommended Guidelines for the Care of Power Boilers
ASME BPVC SEC VIII D1	BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1
ASME PTC 4	Fired Steam Generators

ASTM INTERNATIONAL (ASTM)

ASTM A106/A106M	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A193/A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A312/A312M	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM D 5864	Standard Test Method for Determining Aerobic Aquatic Biodegradation of Lubricants or Their Components
ASTM D 6081	Aquatic Toxicity Testing of Lubricants: Sample Preparation and Results Interpretation
ASTM F 1120	Standard Specification for Circular Metallic Bellows Type Expansion Joints for Piping Applications
ASTM F 1508	Angle Style, Pressure Relief Valves for Steam, Gas, and Liquid Services

FM GLOBAL (FM)

FM DS 12-17	Watertube Boilers

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS (NBBPVI)

NBBPVI NB-27	National Board Rules and Recommendations for the Design and Construction of Boiler Blowoff Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	National Fuel Gas Code
NFPA 85	Boiler and Combustion Systems Hazards Code

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 1110-2-1424	Engineering and Design -- Lubricants and Hydraulic Fluids

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	Color Code for Pipelines & for Compressed Gas Cylinders

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-50558	Valves, Pressure Regulating, Steam

CID A-A-50562	Pump Units, Centrifugal, Water, Horizontal; General Service and Boiler-Feed: Electric-Motor or Steam-Turbine-Driven
CID A-A-59222	Fans, Centrifugal, Draft, Forced and Induced
CID A-A-60001	Traps, Steam
FS F-B-2902	Boilers, Steam Watertube (Bent Tube, Multi-Drum and Cross Drum) Packaged Type (10,000,000 to 125,000,000 BTU/HR Thermal Output Capacity)
FS F-B-2910	Burners, Single Oil, Gas, and Gas-Oil Combination for Packaged Boilers (320,001 to 125,000,000 BTU/HR Thermal Output Capacity)
FS W-H-2904	Heaters, Fluid, Deaerating (For Water Only) 1,000 to 1,600,000 Pounds Per Hour Capacity
FS WW-S-2739	Strainers, Sediment: Pipeline, Water, Air, Gas, Oil, or Steam

U.S. OCCUPATIONAL HEALTH AND SAFETY ADMINISTRATION (OSHA)

29 CFR 1910-SUBPART D	Walking - Working Surfaces

1.3 RELATED REQUIREMENTS

The following UFGS sections apply to this section, with the additions and modifications specified herein:

a. 01 78 23 OPERATION AND MAINTENANCE DATA

b. 03 30 00 CAST-IN-PLACE CONCRETE

c. 09 90 00 PAINTS AND COATINGS

d. 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS

e. 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS

f. 40 17 26.00 20 WELDING PRESSURE PIPING

g. 22 00 00 PLUMBING, GENERAL PURPOSE

1.4 SYSTEM DESCRIPTION

1.4.1 Design Requirements

1.4.1.1 Boiler Design and Service Conditions

a. Refer to schedule for required design performance.

b. Service Conditions:

The new boilers at NASA Ames Research Center will generate steam at the specified conditions, which provides the motive power for the Steam Vacuum System (SVS). Two boilers will normally operate with the third as a standby. The boilers will operate on an intermittent basis with daily start ups and shut downs. A typical daily operating profile is represented in the following table:

SVS Steam Demand		Total Boiler Steam Flow (Incl. Steam to Deaerator)	Boiler Lead		Boiler Lag		Boiler Standby		Duration
	Lbs/Hr	Lbs/Hr	Lbs/ Hr	% Load	Lbs/ Hr	% Load	Lbs/ Hr	% Load	Mins.
start up	0								30
standby	100,599	120,550	60,275	50%	60,275	50%	0	0%	30
peak	173,768	206,836	103,418	86%	103,418	86%	0	0%	15
normal	155,067	184,782	92,391	77%	92,391	77%	0	0%	20
standby	100,599	120,550	60,275	50%	60,275	50%	0	0%	45
peak	173,768	206,836	103,418	86%	103,418	86%	0	0%	15
normal	155,067	184,782	92,391	77%	92,391	77%	0	0%	20
standby	100,599	120,550	60,275	50%	60,275	50%	0	0%	45
peak	173,768	206,836	103,418	86%	103,418	86%	0	0%	15
normal	155,067	184,782	92,391	77%	92,391	77%	0	0%	20
standby	100,599	120,550	60,275	50%	60,275	50%	0	0%	45
peak	173,768	206,836	103,418	86%	103,418	86%	0	0%	15
normal	155,067	184,782	92,391	77%	92,391	77%	0	0%	20
shutdown	0								30

The assigned standby boiler will be rotated on a monthly basis such that all three boilers will be operated with equal use, as much as practicable. Each boiler shall be designed for an average of 129 cold startups and shutdowns annually with corresponding operating hours 903 hours per year. The boilers shall be designed for a minimum life span of thirty five (35) years operating under these conditions, excluding normal and customary maintenance.

1.4.1.2 Economizer

Refer to schedule for required performance

1.4.1.3 Fans

Design fan to handle air at temperatures from 36 to 86 degrees F. Fan shall be single width inlet, single width outlet, with rotation as shown on plan .

1.4.1.4 Expansion Joints and Stacks

a. Temperature:

1. Maximum ambient: 88 degrees F

2. Minimum ambient: 36 degrees F

3. Inlet gas at maximum gas flow (gas): 254 degrees F

4. Inlet gas at minimum gas flow (gas): 244 degrees F

b. Gas Flow at Inlet

1. Maximum: 132,000 lb/hr at rated output

2. Minimum: 66,000 lb/hr

c. Required Net Available Draft at Stack Inlet At maximum gas flow: Calculated by contractor.

d. Gas Exit Velocity (Cone Exit) Maximum at maximum conditions: 300 ft/sec

e. Thermal Efficiency of Stack: 96 to 98 percent

f. Stack Friction Maximum at design conditions:

g. Stack Height

1. Ground elevation: Refer to architectural drawings.

2. Roof elevation: Refer to architectural drawings.

3. Stack height: 70 ft above finished floor.

4. Foundation elevation: Same as finished floor

h. Wind pressure: Refer to structural drawings for wind design criteria

i. Wind velocity, gusting: Refer to structural drawings for wind design criteria.

j. Stack Diameter Minimum (below exit cone): 54 inches

k. Stack deflection Maximum (from vertical center line): 2.0" inches

l. Soil bearing stress, maximum: Refer to structural drawings.

m. Seismic: Refer to structural drawings for seismic design criteria.

1.4.1.5 Deaerating Heater

Refer to schedule for required performance

1.4.2 Detail Drawings

Boiler manufacturer shall provide full and complete documentation for main systems and subsystems. These shall include, but not be limited to, a bill of materials, arrangements drawings, P&IDs, control panel drawings, full logic diagrams, and electrical interconnection diagrams. Drawings shall clearly show what is furnished, pre-piped and pre-wired by the boiler manufacturer, items that are furnished loose but require general contractor installation, and items required to be furnished and installed by the general contractor.

1.4.2.1 Boiler

Show arrangement and details of anchorage, plans, elevations, wall sections, insulation, tubing details, expansion joints, external piping details and schematics, wiring schematics, economizer and economizer structural details. Submit descriptive information with the drawings on each item of the drawings.

1.4.2.2 Boiler Room Auxiliary Equipment

Drawings shall show equipment arrangements, anchorage details, wiring and piping diagrams. Include descriptive information for each item shown. Submit drawings showing the following:

a. Water softening equipment

b. Brine storage tank

c. Deaerator

d. Boiler feed pumps including certified performance curves

e. Continuous blowdown system

f. Chemical feed units

g. Cranes and hoists

1.4.2.3 Burners

Submit drawings showing the following:

a. General arrangement

b. Piping details

c. Burner control schematics

d. Flame safety schematics

e. Component details

f. Throat tile details

g. Anchorage details

1.4.2.4 Dampers, Stacks, and Breechings

Submit drawings showing the following:

a. General arrangement

b. Breeching and reinforcing details

c. Breeching hangers, support, and anchorage details

d. Dampers and operators

e. Access doors and frames

f. Expansion joints

g. Stack details

For stack details, include anchor bolt and foundation details, stack sampling ports, platforms, and accessories.

1.4.2.5 Piping and Specialty Items

Drawings may be manufacturer's standard size. Submit drawings showing the following:

a. Details of special valves and fittings

b. Feedwater regulator details and schematics

c. Details and schematics of feedwater automatic recirculation

d. Anchorage details for design-build pipe supports

1.4.2.6 Forced Draft Fans

Submit product data including:

a. Performance curves

b. Fan motor requirement

c. Fan drive assembly

d. Sound attenuators

e. Anchorage details

1.4.2.7 Drawings

Submit shop drawing of each approved drawing sheet in electronic format to the COR for the following items: Refer to BIM specifications for modeling requirements.

a. Boiler layout, construction and details

b. Breeching layout and details

c. Burner control schematics and burner details

d. Wiring diagrams

e. Automatic feedwater recirculation system

f. Piping schematics

1.4.3 Design Data

1.4.3.1 Engineering Calculations

Furnish the following calculations from the manufacturer:

a. Bid proposal shall include predicted boiler system performance calculations for 100%, 86%, 77%, 50% and 25% load. Performance must include all parasitic loads associated with boiler operation. Appropriate evaluation factors for boilers efficiency and parasitic loads will be applied as part of the evaluation and selection process.

b. Stack

1. Stresses due to various loading conditions including wind and seismic loads.

2. Vibration and damping.

3. Heat transfer at various design and ambient conditions.

4. Expansion profiles.

5. Shipping and erection stress analysis.

1.4.4 Test Reports

Submit the predicted economizer performance along with and as part of the boiler predicted performance report.

1.4.5 Performance Requirements

1.4.5.1 Boiler

Base performance requirements, including furnace heat release rates, on the following ultimate analysis and high heating values.

a. Natural gas analysis: Obtain gas analysis from supplier prior to design, including:

1. Proximate Analysis (percent by volume, as fired)

Methane: percent
Ethane: percent
Propane: percent
Butane: percent
Carbon Dioxide: percent
Nitrogen: percent
Miscellaneous: percent

Total: percent

2. Ultimate analysis (percent by weight, as fired)

Hydrogen: percent
Carbon: percent
Nitrogen: percent
Oxygen: percent
Miscellaneous: percent

Total: percent

3. Heating value: Btu/cu ft

4. Heating value: Btu/lb

5. Density: lb/cu ft

6. Specific gravity: .

1.4.5.2 Economizer

The increase in efficiency due to the economizer shall be not less than 5 percent at full load. Fully coordinate the economizer with the boiler to which it is to be applied.

1.4.5.3 Gas Burner/Windbox Package

Burner turndown ratio shall not be less than ten to one when firing natural gas with excess air not over 15 percent at full steam load, and excess air not over 22 percent at 20 percent steam load. Air flow shall be modulated by modulating speed of forced draft fan, and a single windbox damper for low firing rates.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Submittals required by this section require the approval of the COR. Within 75 days after award of the contract, shop drawings accompanied with complete manufacturer's descriptive information shall be submitted for approval as specified in Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS. Drawing size shall be 34 by 22 inches.

SD-02 Shop Drawings

Boiler

Boiler room auxiliary equipment

Burners

Dampers, stacks, and breechings

Piping and specialty items

Reproducible drawings

The boiler supplier shall provide a 3-D model of all equipment supplied for the project. The models shall be adaptable to the 3D model utilized by the general contractor and shall be capable of being used for equipment layout with respect to the available space and interference checking.

Refer to Section 01 11 00 for Contractor BIM requirements.

SD-03 Product Data

Insulation types and installation procedures

Boiler

Submit documentation indicating Thermal Efficiency.

Local/Regional Materials

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data

SD-05 Design Data

Engineering Calculations

SD-06 Test Reports

Boiler predicted performance

Economizer performance

Variable speed motor controller

Submit certified copies of design, production and conformance tests for approval before delivery of the equipment.

Hydrostatic and leak tightness tests

Preliminary operation

General startup requirements

Boilers and auxiliaries tests and inspections

Submit for tests and inspections as specified in paragraph entitled "Field Quality Control." Submit a detailed written record of test conditions, test procedures, field data, and startup and operational performance of entire heating plant to the COR before the Contractor's operational and test personnel leave the site.

Aquatic toxicity

SD-07 Certificates

Compatibility of boiler components and equipment

System and equipment installation

Submit the required information and experience certificates as specified under paragraph entitled "Experience Requirements," within 30 days after award and prior to commencing work on the site.

Identical equipment

SD-10 Operation and Maintenance Data

Boiler, Data Package 3

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Include the following supplemental information in addition to the requirements of Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS.

a. Illustrations, catalog information, shop drawings, and certified drawings of each item of equipment and control components

b. Tests and test results

c. Adjustments

d. Fan and blower characteristics curves

e. Pump characteristic curves

f. Boiler predicted performance data

g. List of special tools required

h. Posted operating instructions

i. Controls Drawings, Setup and Calibration Data

1.6 QUALITY ASSURANCE

1.6.1 Experience

1.6.1.1 Experience Requirements

The boiler(s), with auxiliary equipment installed, within, or as a part of the heating plant, shall be of a proven design; the manufacturer shall be regularly employed in designing, fabricating, erecting, testing and startup of the equipment for a minimum of 10 years.

1.6.2 Responsibility of the Boiler Manufacturer

Contractor shall ensure that the manufacturers of boiler components and auxiliaries provide equipment compatible with the boiler. Equipment includes but is not limited to the following: Blowdown valves, burner/windbox package, combustion control system, emission control components, fans, economizer, refractories, insulation, steam separator, scanner, breeching between boiler outlet and stack inlet, boiler trim, safety valves and drains.

1.6.3 Assembly of Components

The equipment shall be factory assembled except for steam generators which may utilize factory assembled components to the maximum extent to facilitate erection and minimize field labor.

1.6.4 Certificates

1.6.4.1 Compatibility of Boiler Components and Equipment

Contractor shall submit certifications from the boiler manufacturer stating that boiler components, including auxiliary equipment, are compatible with the boiler. Certificates of compatibility for boiler components and

auxiliary equipment not directly produced by the boiler manufacturer may be submitted through the boiler manufacturer.

1.6.4.2 System and Equipment Installation

Contractor shall submit written certification from each system supplier and each manufacturer of the equipment that the system and equipment installation is in accordance with the system supplier's and equipment manufacturer's instructions and recommendations, that the unit or system has been run, rotating parts have been dynamically balanced, fluid (including air) flows have been balanced, instrumentation and controls are properly functioning, adjusted and have been calibrated, and the equipment or system is ready for final testing. Certificates shall be submitted before the entire boiler plant may be given an acceptance test.

1.6.4.3 Identical Equipment

Contractor shall submit evidence from the equipment manufacturer to show that substantially identical equipment produced by the manufacturer and of comparable operating parameters (within plus or minus 20 percent) has been successfully installed and operated in not less than three installations under comparable operating conditions for a period of not less than two years.

1.7 WARRANTY

Provide warranty, as required in Section 01 86 12.07 40, with a five (5) year period for all steam plant equipment essential for the production of steam for the Steam Vacuum System.

Provide a proposal for an extended warranty of an additional five (5) year period for same steam plant equipment.

1.8 DELIVERY, STORAGE, AND HANDLING

Each assembly of components packaged as a unit shall be of a size that can be transported by common carrier without disassembly insofar as shipping clearances are concerned.

1.9 ENVIRONMENTAL REQUIREMENTS

1.9.1 Burner Emission Requirements

The emission requirements shall be met at the maximum required continuous output. The burner shall meet environmental rules and regulations. Emission requirements to be considered are oxides of nitrogen (NOx), opacity, particulate, sulfur dioxide, and carbon monoxide. Other emission requirements may be imposed.

1.9.1.1 NOx Emission Regulations

Compliance shall be met using one or a combination of the following:

a. Low NOx burners

b. Other NOx reduction techniques. See Nitrogen oxide control for stationary combustion sources.

The specified allowable NOx emissions level shall be achieved without the

use of flue gas recirculation (FGR). If a vendor can only guarantee the NOx emissions with FGR, then he shall demonstrate the proposed equipment can be accommodated within the allocated space as shown on the bid documents.

1.9.1.2 Aquatic Toxicity

Assess potential effects of all lubricants on aquatic organisms in accordance with ASTM D 6081 and submit aquatic toxicity reports. Assess biodegradation in accordance with ASTM D 5864. In accordance with EM 1110-2-1424 Chapter 8, aquatic toxicity shall exceed 1,000 ppm at LL50 and biodegradation shall exceed 60 percent conversion of carbon to carbon dioxide in 28 days.

PART 2 PRODUCTS

2.1 MATERIALS

Provide materials free of defects which could adversely affect the performance or maintainability of individual components or of the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. Unless specified otherwise herein, equipment, material, and articles incorporated in the work covered by this specification shall be new.

All boiler subsystems, such as burner assemblies and SCR shall be fully factory assembled and tested.

2.1.1 Identical Equipment

Provide physically and mechanically identical boilers and equipment of the same classification size or capacity to permit the interchangeability of replacement parts. This requirement includes parts, assemblies, components, and accessories. Parts provided on the same type unit regardless of unit size and identifiable by identical part number shall be functionally and dimensionally interchangeable. No deviation is acceptable without prior written approval of the COR.

2.2 BOILERS

2.2.1 Packaged Watertube Boiler

FS F-B-2902, Type IV except as modified below. Provide lifting attachments.

2.2.2 Tubes

Boiler and furnace tubes shall be at least 2" inches in outside diameter.

2.2.3 Furnace

Orientation of furnaces for D-type boilers shall be as shown on plan.

Boilers shall be of full water cooled membrane furnace construction, including front and rear furnace walls. Due to the frequency of startups and shutdowns resulting in excessive cycling of heating and cooling, refractory walls will not be allowed.

2.2.4 Transition

Provide a transition piece to permit adapting the economizer outlet to the stack. Design transition pieces for horizontal discharge and wye connection to stack.

2.2.5 Combustion Controls

As specified in Section 40 95 00 PROCESS CONTROL

2.2.6 Access and Observation Doors

Provide boiler with sufficient number of access doors and observation doors, to give free and easy access and observation to all parts of the interior of the boiler.

2.3 ECONOMIZERS

Provide a modular unit constructed in accordance with the ASME Boiler and Pressure Vessel Code, Section IV, of the following type:

a. Finned or Spiral Wound Tube Type: Feedwater circulates through finned tubes and flue gas flows through outer shell.

2.3.1 Construction

Provide manufacturer's standard economizer design for the operating conditions and the fuel(s) specified. Coordinate the amount of heating surface with the flue gas conditions exiting the boiler or boilers on which the economizer is to be applied to preclude reaching the "acid dew point" for the fuels specified. Provide casing of not less than 12 gage steel plate reinforced as required with support lugs and breeching flanges. Provide building framing steel to support the economizer. Design the economizer so that internal construction can be easily cleaned and inspected.

2.3.2 Equipment

Provide the following equipment for each unit:

a. Relief valves.

b. Shutoff gate valve on feedwater outlet and shutoff globe valve on inlet with globe valve bypass. Size valves as shown in economizer piping detail.

c. See Section 40 95 00 PROCESS CONTROL for economizer instruments and controls.

d. A drain valve downstream of the economizer before the shutoff valve.

e. A stack flue gas temperature control system to control and limit flue gas temperature to not less than 300 degrees F by modulating motorized feedwater control valves in a bypass around the economizer. Provide shutoff valve on each side of the control valves with a strainer upstream of valves. Provide this system in parallel to the manual shutoff and bypass described above.

f. Differential pressure indicator on water side.

g. Differential pressure indicator on gas side.

h. Pressure gages on feedwater inlet and outlet.

2.3.3 Insulation

Insulate the economizer with not less than the equivalent of 2 inches of mineral wool insulation and lag with not less than 20 gage galvanized, weatherproof lagging.

2.4 BURNER AND WINDBOX PACKAGES

2.4.1 Gas Burner/Window Package

Provide, fully modulating natural gas fuel burner conforming to FS F-B-2910, Class 3, Combustion control system except as modified below. Provide burner with windbox, forced draft fan, dampers, fuel train and associated controls to comprise a complete factory assembled package. Total heat input to the boiler furnace shall be provided by one burner. Burner package shall be considered an integral part of the steam generator and shall be subject to applicable provisions of the boiler design and service together with requirement of tests, performance guarantees and other warranties specified for the boiler.

2.4.1.1 Burner

a. Burner Characteristics: The burner shall be quiet in operation and shall operate with a balanced clean stable flame so as not to localize heat in any part of the combustion chamber. The air admitted shall be of sufficient quantity for complete combustion, but not of such quantity as to produce an undue percentage of excess air with attendant high stack loss. The burner shall operate without clogging or failure, and shall have sufficient capacity to develop not less than the specified capacity. The burner unit shall be easily removed from firing position and readily accessible for inspection, cleaning, and other purposes. Provide adequate observation ports on burner. There shall be no flame impingement on the sidewalls, top, bottom or rear walls of the furnace. Contractor shall install items provided by the burner manufacturer which may be required for proper installation of the burner.

b. Natural Gas Pilot Ignition System: Provide a complete interrupted type natural gas-fired, spark ignited pilot system for the burner assembly. Combustion air supply shall be from the burner windbox. Lighting system shall have capacity to stabilize the firing during startup periods. Lighter shall be arranged for easy removal and servicing while the boiler is in operation. Furnish igniter complete with a spark rod and a power pack. Power pack shall operate on 120 volt, 60 cycle, single phase power. Provide gas piping, to one point of supply, including necessary gas pressure regulators. Igniter system shall include controls, gages, flame safety systems, interlocks and accessories to comply with Industrial Risk Insures' (I.R.I) (formerly F.I.A.) requirements and applicable codes and regulations.

c. Windbox: Construct of carbon steel plate not less than 10 gage thickness with 1/4 inch thick front plate. Design windbox to provide even and uniform air entrance into the burner register and seal weld to the boiler front wall. Provide windbox with support legs.

d. Materials: Metal parts exposed to radiant heat, including the atomizer shield, shall be of stainless steel or other approved alloy.

e. Natural Gas Control Valve: Natural gas shall be supplied at 17 psig and 50 degrees F at the inlet of the fuel piping train. Size the natural gas automatic control valve for appropriate differential pressure .

f. Fuel: natural gas.

2.4.1.2 Flame Safeguard Controls

Provide a complete system of valves, interlocks and controls in accordance with NFPA 85 and as approved by Factory Mutual Engineering and Research. See Section 40 95 00 PROCESS CONTROL for boiler controls.

a. Natural Gas Train: Provide UL or FM approved gas train. Provide natural gas train consisting of gas ring, gas control valve, two safety shutoff valves, high gas valve, and manual shutoff cock. Provide low gas pressure switch, high gas pressure switch, and other safety interlocks and devices as required. Provide in panel mounted on burner package the following gages. Gages shall be 6 inch with white coated dial and black figures.

1. Natural gas supply (0 to 25 psig)

2. Burner gas supply pressure (0 to 25 psig)

2.5 FANS

2.5.1 Forced Draft Fan

CID A-A-59222, Type VI, Class 1, except as specified otherwise.

2.5.1.1 Fan Size

Size fans for complete combustion of fuel at maximum firing rate taking into account design allowances, corrections for burner pressure drop, furnace pressure, combustion air temperature, plant elevation, and other design factors including allowance for economizer. After fans have been sized in accordance with the above, add the following allowances for momentary overloads and normal deterioration of fans, firing equipment and boilers:

a. Excess volume: 10 percent

b. Excess pressure: 20 percent

2.5.1.2 Fan Construction

Construct fan wheel of steel. Direction of fan discharge shall be easily changed at angles of 45 degrees. Provide fan with roller bearings mounted in pillow blocks.

2.5.1.3 Electric Motor

Motor for driving the forced draft fan shall be premium efficiency variable speed, 460 volt, three phase, 60 Hz, totally enclosed, fan cooled not less

than 200 hp, as specified under "Motors and Drives" in this section, and shall not overload at the specified capacity with unheated cold air. Provide steel soleplate for motor. Soleplate must be common for all four motor mounting bolts. Separate parallel soleplate bars are not acceptable.

2.5.1.4 Noise Level

Noise level shall not exceed 85 dBA sound pressure level at 5 feet above the floor and 5 feet from the fan in any direction. Provide heavy duty sound attenuator with screen on fan inlet, if required, to meet the sound pressure level requirements.

2.6 COMPRESSED AIR SYSTEM

2.6.1 Pressure Reducing Regulator

Provide self-operating type designed for not less than a 250 psig operating pressure, and a normal operating temperature range of minus 20 degrees F to plus 150 degrees F. Regulator shall have an adjustable outlet pressure range not less than 5 to 100 psig with not less than four ranges. Provide external adjusting screw for adjustment throughout each spring range. Provide internal pressure tap for outlet pressure regulation.

2.7 BREECHING, EXPANSION JOINTS, STACKS, AND DAMPERS:

2.7.1 Breeching

Provide with rectangular cross section and fabricate of not less than 3/16 inch thick black steel plate unless otherwise noted. Stiffeners shall be not less than 2 1/2 by 2 by 1/4 inch steel angles welded to exterior with 2 inch leg outstanding. Stiffeners shall not exceed 3 feet on centers. Breeching shall connect to each boiler flue gas outlet, intermediate heat recovery equipment, air pollution control equipment, and to stack as required.

2.7.1.1 Breeching Connections and Joints

Weld or bolt breeching joints unless indicated otherwise. Welding shall conform to AWS D1.1/D1.1M and AWS D1.3/D1.3M. Bolts for bolted connections shall be not less than 1/2 inch diameter and spaced not more than 3 inches apart, with bolts, lockwashers and nuts being hot-dipped galvanized. Provide bolted joints with a minimum of 1/8 inch thick gaskets. Bolt breeching connections to boilers, equipment items, dampers, expansion joints, and breeching accessories. Flanged breeching connections to equipment shall be drilled to match flanges on equipment. Flanged joints shall be seal welded to make connection gas-tight. Provide 45 degree wye type connection to stack.

2.7.1.2 Breeching Access Doors

Provide breeching access doors where indicated. Construct access doors with frame and hinged door of cast iron or reinforced steel plate. Frame shall be not less than 25 by 37 inches with access opening of 18 by 30 inches. Connection to breeching shall be gasketed and made with minimum 1/2 inch diameter hot-dipped galvanized bolts, lockwashers, and nuts spaced not less than 5 inches on center. Each side of the access door shall have not less than two quick-clamp positive closing latches, with the long side opposite the hinges containing three clamps to give a gastight seal. Side of access door opposite hinges shall contain a minimum 3 by 5 inch size

handle. Provide a gasket consisting of 3/8 inch diameter fire resistant resilient rope seal and mastic compound between the access door and the access door frame.

2.7.1.3 Breeching Cleanout Doors

Provide breeching cleanout doors where indicated. Construct cleanout doors of not less than 3/16 inch thick steel plate. Secure cleanout doors to a 1 1/4 by 1 1/4 by 3/16 inch thick angle frame with 3/8 inch hot-dipped galvanized mounting bolts welded to the angle frame and spaced not more than 6 inches o.c. Weld frame to breeching and provide a 1/16 inchgasket between frame and cleanout door. Cleanout doors shall be not less than 24 inches square except where breeching dimensions are smaller, in which case the cleanout door shall be full height of the breeching and not less than 12 inches in length.

2.7.1.4 Breeching Structural Materials

Structural and support materials shall be steel and shall comply with the applicable sections of ANSI/AISC 360. Support and stiffen breeching as indicated.

2.7.2 Expansion Joints

2.7.2.1 Metallic Breeching Expansion Joints

Provide factory fabricated metallic breeching expansion joints where indicated. Expansion joints shall be guided metal bellows type capable of a minimum of 1.5 inches of axial travel. Form metal bellows from not less than 1/16 inch thick type 321 stainless steel plate. Cover plates shall be not less than 1/8 inch thick steel plate.

2.7.3 Stacks (For Installation Without Flue Gas Scrubbers)

Stacks shall be free standing, dual wall with insulated annular space, self supporting, steel construction. Contractor shall assure that the design of the stack and supporting steel or concrete foundations meets or exceeds the design conditions listed below. Provide each stack complete with accessories and appurtenances, including test ports, sampling platforms, caged safety ladders, anchors, sleeves, insulation, base and chair rings, and cleanout door.

2.7.3.1 Construction

a. Opening Reinforcement: Provide openings with adequate reinforcement to minimize stress concentrations.

b. Shell: Design wall thickness of the shell to be 1/16 inch thicker than that required by dynamic and static structural design but not less than 1/4 inch. Limit design deflection to 2"

c. Expansion Devices: Construct of corrosion resistant stainless steel suitable for the temperatures and flue gas combinations to be experienced by the stacks.

d. Base construction of the stack shall transmit forces and moments in the shell to the foundation without local stresses of appreciable magnitude being induced in the shell or exceeding the allowable stresses of the supporting concrete.

e. Provide openings in breeching and stack for test equipment for sampling flue gas and for metering devices. Openings shall be properly reinforced and designed for differential expansion. Breeching opening shall be of wall construction. All penetrations through shell of stack shall be completely welded to provide proper sealing between the stack and the opening.

f. Anchor Bolts: provide suitable anchor bolts.

2.7.3.2 Construction Accessories

Accessories to be provided:

a. Cleanout Door: Provide double wall insulated steel plate door complete with one inch round hinge pin, gasket and not less than 18 swing bolts.

b. Ladder: Provide each stack with an external ladder with cage for access to sampling platform. Construct ladder and cage of corrosion resistant steel in accordance with ALI/LADDER A14.3.

c. Thermocouples: Provide a flue gas sensing thermocouple well with thermocouple 3 feet above the breeching opening and 5 feet below the top of the stack. The wells shall be CRES and shall extend about halfway into the stack.

2.7.3.3 Finish

Stacks shall be shop coated prior to shipping from the factory.

2.7.3.4 Stack Sampling Platform

Provide stack sampling platform conforming to the requirements of 29 CFR 1910-SUBPART D.

2.7.4 Dampers

2.7.4.1 Multilouver Dampers

Provide factory fabricated multilouver dampers with or opposed blade type operation. Construct damper frame of distortion resistant welded steel channels with raised seat to ensure free nonbinding operation of blades and to keep blades square in the frame. Construct blades of 1/4 inch thick steel plate in a stressed skin airfoil-shape with fully welded seams containing no external ribs. Blade shafts shall be stainless steel. Blades shall be pinned to blade shafts. Louver shaft bearings shall be outboard type and shall be self-lubricating and self-cleaning. Bearing seals shall be gas-tight.

a. Multilouver Damper Linkage: Damper linkage shall be adjustable and of pinned construction for easy removal and shall be designed to handle full operation torque. Linkage on dampers in clean flue gas areas shall operate from a single connection point. Design linkage on dampers in dirty flue gas areas, between boiler outlet and inlet to air pollution equipment, so that the bottom blade linkage arm is not connected to the above linkage, to allow this blade to operate separately. The remaining linkage for this damper shall be constructed to operate from a single operating point.

b. Two-Position Damper Operators shall be pneumatically operated with air cylinder, four way valve, and solenoid valve arrangement.

2.7.5 Sampling Ports

Weld two sampling ports to stack at 90 degrees apart. Each port shall consist of a section of 4 inch diameter steel pipe with threaded cap.

2.8 MISCELLANEOUS EQUIPMENT

2.8.1 Deaerating Heater

2.8.1.1 General

Provide a deaerating feedwater heater with storage tank conforming to FS W-H-2904 and to ASME BPVC SEC VIII D1. Tank shall be ASME Code stamped. Register vessels with the National Board Pressure Vessel Inspections. Provide stainless steel trays. No test model will be required.

Model A - Pressurized operation.

Type I - Tray-type heating and deaerating element.

Class 3 - Water storage capacity (minimum) as scheduled on drawings.

Grade A - Guaranteed removal from water of dissolved oxygen in excess of 0.0012 in3/gal, over a ten to one load swing.

2.8.1.2 Heater Capacity

Provide deaerating heater capable of heating and deaerating makeup water consisting of 213,000 pounds per hour of softened makeup water from 50 degrees F to 232 degrees F (outlet temperature).

2.8.1.3 Inlet Water Characteristics

Softened makeup water:

pH: See WATER SOFTENING specifications

Total hardness (as CaC03): 0.2 ppm

2.8.1.4 Storage Tank

Horizontal design with steel supports drilled for bolting of approved design. Provide storage tank with not less than a 16 by 20 inch minimum size manhole and cover and provide heater section with not less than a 16 by 20 inch minimum size tray access handhole and door.

2.8.1.5 Vent Condensing Arrangement

Provide the deaerating heater with a vent condenser which shall condense the vented steam when the heater is operating at full capacity with the inlet water mixture at a temperature not exceeding 180 degrees F. Construct the vent condenser, when of the direct contact type, with stainless steel baffling.

2.8.1.6 Materials

Construct trays, tray supports, water distributors, and other parts coming in contact with undeaerated water or air laden steam of 430 stainless steel.

2.8.1.7 Accessories

Provide deaerating heater with the following accessories:

a. Pressure Relief Valve: Sized in accordance with ASME BPVC SEC VIII D1.

b. See Section 40 95 00 PROCESS CONTROL for deaerator instruments and controls. Thermometers with lagging extension type wells for the storage tank and the heater section.

c. Lifting attachments for the tray section and the storage tank.

d. Water Gage Glasses: Reflex type with shutoff valve and guards.

e. Float Controllers:

    1. Makeup water controller

    2. Overflow controller

f. Overflow Control Valve:

g. Storage Tank Gage Glass: Full height, shielded, for storage tank including shutoff valve and drain cocks.

h. Makeup Water Inlet Control Valve:

i. Switches: For low water level alarm in the storage tank, high water level alarmin the storage tank, and low steam pressure alarm. Install switches on a single column with connections valved and unions provided in pipe on each side of each float switch.

j. Special tools: One set for maintenance.

k. Furnish pipe, fittings, controls, specialties, bolts, gaskets, drains, and valves, necessary for proper attachment of accessories and trimmings and install.

2.8.1.8 Connections

Provide necessary connections for condensate, steam, makeup water, removal of vented gases, vacuum breakers, discharge of deaerated water, and instruments and controls.

a. Provide heater connections as follows:

    1. 16 inch steam inlet

    2. 8 inch makeup water inlet

    3. 3/4 inch high pressure trap return

    4. relief valves sized as required

5. 2 inch vent

6. Thermometer well

7. Pressure gage

8. Vacuum breakers as required

9. 10 inch heater drain

10. 2 inch spare flanged

11. 1 inch spare capped

12. Handholes and manhole with covers

b. Tank connections shall include:

1. 8 inch drain

2. 2 inch boiler feed recirculation (3 required)

3. One inch sampling

4. One inch chemical feed

5. Sight glass (1 sets required)

6. High and low level alarm switches

7. thermometer well

8. Vacuum breakers as required

9. 1 inch spare (capped)

10. 4 inch spare (flanged)

11. level transmitter and controller (1 sets required)

12. Downcomer and equalizer as required

13. 10 inch feedwater outlet

14. 8 inch overflow outlet with internal water seal

2.8.1.9 Level Control

Provide an automatic control system to control water level in the storage tank, by modulating valves in makeup water lines. See Section 40 95 00 PROCESS CONTROL for controls

Air Operated Regulating Valves: Provide air operated control valves for the makeup water lines. Valves shall have Class 125 or Class 150 rating with iron or semi-steel bodies and 316 stainless steel internals. Provide makeup water valve with an air lock mounted on valve diaphragm to hold valve in last position on loss of air. Refer to schedule on drawings for valve requirements.

2.8.1.10 Low Pressure Steam Control

Provide an automatic control system to control the steam to the deaerating heater. Maintain steam pressure in the heater by modulating a pressure reducing valve in the steam supply line. Control shall be local and remote from the control panel.

a. Controller: Adjustable proportional band, 0 to 15 psig brass bellows for input signal, and 3 to 15 psig output air pressure range, pilot controller complete with air set (valve, filter, drier and pressure regulator) mounted on control valve yoke.

b. Pressure Reducing Station Control Valve: Provide an air operated pressure reducing valve with proper internals to pass a flow of steam as scheduled. Steam at the valve inlet shall be 425 psig saturated, and the outlet shall be controlled at 7 psig. See schedule for minimum steam flow and minimum valve Cv at 100 percent open. Valve shall be Class 300 flanged.

2.8.1.11 Gage Glasses

Provide gage glasses to cover the entire range of water level in the storage section. Gage glasses shall not be greater than 24 inches center-to-center. Provide gage glasses complete with chain operated ball check shutoff and drain cock valves and safety shield.

2.8.1.12 Alarms

Provide high and low water level alarms for storage tank as follows:

a. High Water Level Alarm: Switch with stainless steel float and trim. Locate switch to close circuit when water level rises to one inch below overflow level of storage tank.

b. Low Water Level Alarm: Switch with stainless steel float and trim. Locate switch to close circuit when water level falls to ?? feet ?? inches above bottom of storage tank.

c. Coordination: Coordinate alarms with annunciator panel as indicated.

2.8.2 Boiler Feed Pumps

CID A-A-50562, Type II (boiler feed pump), Class 2 (multi-stage) except as modified below. Multistage split ring type pump with suction and discharge connections on top of pump body.

See Section 43 21 13 PUMPS: WATER, CENTRIFUGAL for additional requirements.

2.8.2.1 Pump Service Requirements

Refer to schedule for required performance

a. Pumping temperature: 232 degrees F

b. Liquid pH: See chemical treatment specifications.

c. Available NPSH: 15.4 feet

2.8.2.2 Construction

Boiler feed pumps shall be as specified on the equipment schedule drawing. Provide casing with suction and discharge gages in tapped openings. Mount each pump and prime mover on a fabricated steel bed plate having a drip collection chamber with tapped drain openings. Provide lifting attachments to enable equipment to be set into its normal position and to enable pumps to be easily dismantled in place.

2.8.2.3 Electric Motors

Variable speed, totally enclosed, fan cooled, 460 volt, three phase, 60 Hz , as specified under "Motors and Drives" and "Variable Speed Control For Motors" in this section. Variable speed electric motors direct connected to respective pumps with a gear type, forged steel, flexible coupling. Provide a shaft and coupling guard.

2.8.2.4 Minimum Flow Protection for Boiler Feed Water Pumps

a. Boiler Feedwater Automatic Recirculation System: Provide a boiler feedwater automatic recirculation system to protect the feedwater pumps at low flow conditions. System shall be capable of recirculating the minimum flow recommended by the pump manufacturer. The system shall be an engineered system consisting of the various functional components specified . Components of the engineered system shall include a flow transmitter in feedwater line, bypass flow controller with bypass flow control valve, and a bypass pressure reducing orifice.

    1. System Bypass Flow Controller: Include detection of low flow and modulation of a control valve in a bypass line returning to a low pressure vessel. Incorporate a pressure let-down feature or device to reduce the pressure from the boiler feedwater pump discharge pressure to that of the low pressure sink. Refer to Instrument and Controls Specification.

    2. System Bypass Control Valve: Modulate to provide minimum flow recommended by the pump manufacturer and to provide shutoff when feedwater flow to the boilers exceeds the minimum flow required for pump protection.

b. Feedwater Stop and Check Valves: Provide a Class 600, flanged, cast steel feedwater stop gate valve and check valve on the feedwater outlet of each pump. Provide piping from the valves to the economizer inlet, and from the economizer to the flanged connection on the boiler drum. Provide connection on pipe at economizer outlet for remote recording thermometer. Refer to piping diagrams and P&IDs.

2.8.3 Variable Speed Motor Controller

Remotely installed cabinet housed units with solid state rectification and inverter equipment to vary frequency of electrical power to the drive motors.

2.8.3.1 Housing

House the controller in a floor mounted, NEMA 4 enclosure finished with manufacturers standard painted finish. Provide control panel complete with fused disconnect switches, magnetic across the line part winding starters with thermal overload protection, transformer, hand-off-automatic selector

switches, hand potentiometer for manual speed control, fuses and running lights.

Manual Switch: Locate the manual switch within the control panel so that in the event failure of any of the components the motor can be put across the line at full voltage to maintain air or pump pressure. Provide a mechanical door interlock that allows the panel to open only when the fused disconnect is in the off position.

2.8.3.2 Variable Frequency Controllers

Variable frequency controllers shall use solid-state semiconductor power conversion equipment. Provide controllers as integrated and assembled products. Controllers shall be furnished by the same manufacturer.

2.8.3.3 Ratings

Each controller shall be rated for a supply of 460 volts, three phase, 60 Hz. The output shall be 460 volts, three phase with frequency variable between zero and 60 Hz. Controllers shall be rated to operate the motors continuously at their rated horsepower and frequency. Speed regulation shall be within (plus or minus) three percent of set point without tachometer feedback. Electrical supply system shall have an available short circuit symmetrical Ampere rating as required.

2.8.3.4 Minimum Speed

Each controller shall be capable of driving the motor continuously at a lower speed no greater than 20 percent of full rated motor speed with stable operation and without overheating the motor under rated ambient conditions. Provide estimate of minimum speed at which motor can be operated continuously without overheating or problems of instability due to overhauling of the load.

2.8.3.5 Fault Protection

Provide controller fault protection so that a single or three phase short circuit at the controller terminals or inverter commutation failure will not result in damage to power circuit components. Provide overload protection so that motor and controller are protected against operating overloads.

2.8.3.6 Time Delay

Provide adjustable time delay under voltage protection so that motors will continue to operate during momentary voltage fluctuation or loss of voltage. Time adjustment shall be zero to 5 seconds. Provide for orderly shutdown on undervoltage conditions exceeding the time delay interval.

2.8.3.7 Acceleration/Deceleration

Provide adjustable timed linear acceleration and deceleration.

2.8.3.8 Voltage/Frequency Control

Provide volts/Hz control to prevent motor overheating throughout the speed range.

2.8.3.9 Door Interlocks

Provide door interlocks to prevent opening of enclosure doors unless power is disconnected.

2.8.3.10 Shutdown Conditions

Controllers shall be self protecting and shall provide orderly shutdown for, but not limited to, the following conditions:

a. Loss of input power

b. Undervoltage

c. Sustained gradual overload

d. Fault or large instantaneous overload

e. Overtemperature

f. Failure of ventilating system

g. Overvoltage

h. Control circuit failure

Provide contacts for remote annunciation of shutdown or abnormal condition.

2.8.3.11 Electrical Bypass

Provide each controller with manual isolation and bypass switching. Switch shall be manually operated with controller deenergized. Switch shall be two position with provisions for locking the switch in either position.

a. Normal Position: Bypass shall be open and connect controller to the supply circuit and the load.

b. Bypass Position: Bypass shall be closed and the controller shall be electronically isolated from the supply and the load. Isolating contacts shall be located so that it is possible to verify by visual inspection that the contacts are open and the controller is electrically isolated. In the bypass position the motor shall be operated at constant speed and controlled from the air circuit breaker. Provide auxiliary contacts that close in the bypass position. Auxiliary contacts shall be used to activate the damper control to provide fan load control in the bypass position.

2.8.3.12 Controller Environmental Protection

a. Ventilation: Design controllers enclosed and ventilated for installation in a moderately dusty area. Provide forced filtered ventilation including fans, filters, controls and accessories required for operation. Enclosures shall be operated under positive pressure at all times. Provide filtered ventilating openings and gasketed doors to prevent infiltration of dust.

b. Heating: Provide electric heaters to prevent condensation in the enclosure and to prevent low ingoing air temperatures that exceed the equipment rating. Provide a low temperature alarm to sound when

enclosure temperature falls below required minimum temperature. Provide contacts for remote annunciation of alarm condition.

2.8.3.13 Method of Control

Supply each controller from an electrically operated air circuit breaker or motor starter. Controller ventilation and heating shall be from another circuit.

a. Start Signal: Closes the electrically operated air circuit breaker or motor starter to energize the controller. The controller shall accelerate the fan to operating speed. Fan speed shall be controlled from the load control signal.

b. Stop Signal: Opens the electrically operated air circuit breaker or motor starter to deenergize the controller. Upon deenergization, the controller control system shall revert to the stop condition.

c. Boiler Feedwater Pump Speed Control System: Matches pump discharge to system demand and maintains a system header pressure controlled to the set point values. Provide Manual/Automatic control stations for master pressure and for each boiler feed pump. Provide indicators for feedwater header pressure and individual boiler feedwater pump flow.

2.8.4 Valve Actuators

Electrically or pneumatically operated and designed so that valve may be manually operated by removing the drive pins. Actuators shall be operated by push button control. Locate one push button at a position adjacent to the valve. Locate a second push button within the boiler control room. Provide a valve position indicator utilizing indicating lights. A green light shall indicate the valve is fully open and an amber light shall indicate the valve is fully closed. Both lights on shall indicate when the valve is partially open. Provide torque limit controls to protect the valve during opening and closing for electrically operated valves. Actuator electric motor shall be totally enclosed, as specified under paragraph entitled "Motors and Drives" in this section. Provide NEMA 4 control enclosures.

2.8.5 Blowdown Tank

Provide a welded blowdown tank sized in accordance with NBBPVI NB-27, (supplemental to the National Board Inspection Code) latest edition published by the National Board of Boiler and Pressure Vessel Inspectors, Columbus, Ohio.

2.8.5.1 Construction

Construct equipment and accessories in accordance with the requirements of the ASME BPVC SEC VIII D1 for a working pressure as scheduled on drawings, but in no case shall the plate thickness be less than 3/8 inch. Provide corrosion allowance of 0.1 inch . Tank dimensions shall be as scheduled on drawings. . Provide tank with wear plate not less than 3/8 inch thick and 18 by 20 inch manhole.

2.8.5.2 Tank Connections

Provide the following connections:

a. Feedwater tank drain 8 inch;

b. Tangential bottom blowdown inlet 2 inch;

c. Steam vent, flanged 10 inch;

d. Discharge water outlet, flanged 4 inch with internal water seal and 3/4 inch siphon breaker;

e. Two inch drain;

f. Thermometer connection 3/4 inch;

g. Pressure gage connection 1/4 inch;

h. Two gage glass connections 1/2 inch.

2.8.5.3 Angle Supports and Coating

Provide tank with steel angle support legs extending a minimum of 1 feet below bottom of the tank. Coat tank with one coat of manufacturer's standard high temperature primer.

2.8.5.4 Accessories

a. Gage Glass: 12 inch reflex type with shutoff valves and guard;

b. Thermometer:

c. Pressure Gage: and

d. Internal Baffles and Pipes: As detailed.

2.8.5.5 Controls

Provide a self operating regulator to control the flow of cooling water to the discharge pipe . Regulator shall include a 3/4 inch screwed bronze body with stainless steel trim, reverse acting actuator (for cooling), capillary tubing and a union connection bulb with a stainless steel well. Control setting shall be 140 degrees F with a minimum Cv.

2.8.6 Continuous Blowdown System

Provide a complete automatic continuous boiler blowdown system which shall include a controller/programmer unit and flow assembly for each boiler, plus a continuous blowoff heat exchanger, flash tank and boiler water sample cooler.

2.8.6.1 Automatic Blowdown Controller

Intermittent type boiler blowdown system rated for not less than 250 psig steam pressure.

2.8.6.2 Flow Assembly

Include a one inch ball valve with 316 stainless steel ball and stem and stainless steel electrode assembly.

2.8.6.3 Controller/Programmer

Include a conductivity meter with zero to 6000 microhms range, valve open/closed indicators and manual/auto control switch. Cycle interval and sample duration shall both be adjustable over a wide range. Mount units at operating floor near boiler front.

2.8.6.4 Accessories and Connections

a. Continuous Blowdown Connection: At each boiler, provide a gate valve and extend piping to header at flash tank.

b. Header Connections: Provide with a tee with valved sampling connection. Provide a 3/4 inch, three globe valve bypass around each flow assembly.

c. Common Header: Provide from valved outlet connections on flow assembly units to connection on flash tank.

2.8.6.5 Flash Tank

Designed for 30 psig and constructed in accordance with the ASME BPVC SEC VIII D1. See schedule on drawing for minimum dimensions. Tank shall be ASME Code stamped and registered with the National Board.

2.8.6.6 Blowdown Inlet

Provide tank with blowdown inlet, steam outlet, gage glass,, relief valve, and inspection openings.

2.8.6.7 Automatic Control System

Control level in the flash tank, by modulating a valve in the water outlet line.

a. Outlet Water Valve: 2 inch air operated control valve with a capacity to pass 40 gpm. Cv shall not be less than scheduled at 100 percent open. Valve shall be Class 150, flanged, iron or semi-steel body with stainless steel internals. Valve shall have equal percentage flow characteristics with a full size port. Provide an air lock mounted on valve diaphragm and piped to hold valve in last position on air failure.

2.8.6.8 Sample Cooler

Water cooled shell and tube type with valves and accessories required to safely withdraw a water sample from the boiler drum. Pipe sampling line to cooler over sampling sink. Terminate sampling outlet 9" above sink pan.

2.8.6.9 Heat Exchanger

Provide an ASME code stamped continuous blowoff heat exchanger designed and constructed in accordance with ASME BPVC SEC VIII D1 to transfer heat from the continuous blowoff water leaving the continuous blowoff flash tank to the treated makeup water entering the feedwater heater. See equipment schedule for performance and type. See Section 23 81 48 PLATE HEAT EXCHANGER.

2.9 PIPING

Piping work shall include the provision of piping systems, including valving and specialty items, for the steam plant and related external auxiliary equipment. Boiler connected piping materials, design, and fabrication shall be in accordance with ASME B31.1 except as modified below or indicated otherwise. All other plant piping shall conform the applicable design code listed in Pipe Data Schedule on drawings. Provide piping materials suitable for the maximum pressure at the maximum temperature at which the equipment must operate. Compute expansion of pipe with operating temperatures above zero degrees F using zero degrees F for minimum temperature, in lieu of 70 degrees F as specified in ASME B31.1.

2.9.1 Piping Materials

a. Steam Pipe, Boiler Feedwater Pipe, Relief Pipe : Steel See Pipe System Material Schedules on drawing.

b. Condensate Pipe and Boiler Blowdown Pipe: Steel See Pipe System Material Schedules on drawing. Wall thickness not less than extra strong (XS or Schedule 80).

c. Chemical Feed Pipe: ASTM A312/A312M austenitic stainless steel.

d. Heating Water, Drains (Other Than Sanitary), and Overflow Pipe: ASTM A53/A53M, black, welded or seamless steel up to a maximum pressure of 150 psig or ASTM A106/A106M, Grade A or B.

e. Gas Pipe and Compressed Air Pipe: See Pipe System Material Schedules on drawing.

f. Instrument Air Pipe: ASTM A312/A312M austenitic stainless steel.

2.9.2 Chlorinated Polyvinyl Chloride (CPVC)

Chlorinated polyvinyl chloride (CPVC) and other plastic tubing and fittings shall not be used in the steam heating plant. Systems for potable water, sanitary drains and storm drains are covered in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.9.3 Fittings

2.9.3.1 Fittings for Steel Pipe

a. Sizes 1/8 to 2 inches: ASME B16.11 steel, socket welded end fittings.

b. Sizes 1/8 to 24 inches: ASME B16.9 steel, butt welding fittings.

c. Sizes 2 1/2 to 24 inches: ASME B16.5 forged steel, flanged fittings.

2.9.3.2 Welded Outlets and Welding Saddles

Make branch connections of 45 and 90 degrees either with MSS SP-97 forged steel welded outlet fittings or welding saddles. Welding outlets and saddles shall not be larger than two pipe sizes less than the main pipe sizes.

2.9.3.3 Unions

a. Unions For Steel Pipe: MSS SP-83 socket weld, except ASME B16.39 threaded for heating water supply and return. Unions for zinc coated pipe shall be zinc coated.

2.9.4 Flanges

ASME B16.5, forged steel, welding type, raised face. Flat face flanges are prohibited. Except as specified otherwise, pressure and temperature limitations shall be as specified in ASME B16.5 for the proper class and service. Flange bore shall match inside diameter of connecting pipe. Refer to pipe system designations on drawings for flange Class.

2.9.5 Valves

2.9.5.1 Ball Valves

ASME B16.34 and API Std 607 double stem seal type for bubble tight shutoff. Seats and seals shall be TFE material. Ball and shaft shall be stainless steel. Provide mechanical stops to prevent cycling valve in wrong direction and self-aligning stem seal. ASME B16.5 for flanged connections.

2.9.5.2 Valve Accessories

Valve operating mechanisms including chain wheels, gear operators, floor stands, electric motors, air motors and cylinder-type actuating devices. Provide accessories as follows and as indicated.

a. Provide power operators with remote position indicators onvalves where specified or required by Sequence of Operation..

b. Provide floor stands and valve extensions on platforms and floors where indicated.

c. Provide motorized actuators or chain wheels with chain and guides on valves with handwheel centerline higher than 7 feet above the floor or platform except where specified otherwise. Chains shall extend from valve to within 3 feet above floor. Provide impact chain wheels on steam headers and other locations where valve has a tendency to stick. When a valve is motorized, provide hand operation for emergency.

d. Provide gear operators on ball valves larger than 3 inches and on gate valves 8 inches and larger.

2.9.5.3 Steam Pressure Regulating Valves

Refer to control valve schedule for specific selections. CID A-A-50558, minimum of Class 300, except as specified otherwise. Cast steel valve body with valve seats and disc of replaceable heat treated stainless steel. Valves shall be single seated, shall seat tight under dead end conditions, and shall go to the closed position in the event of pressure failure of the operating medium. Valves shall be spring loaded diaphragm operated type, except valves exposed to the weather shall be piston operated type. Capacity of valves shall be not less than that indicated. Pilot valves shall have strainer at inlet from external feeder piping.

a. Spring Loaded Diaphragm Operated Valves: Fabricate main spring of

stainless steel, which shall not be in the path of steam flow through the valve. Control valve by pilot valve through external feeder piping.

b. Piston Operated Valves: Control valve by integral pilot valve through external feeder piping.

2.9.5.4 Safety Relief Valves

ASME BPVC SEC I ASTM F 1508, Style D or E, with Class 300 inlet flange, with test lever, designed for the intended service for boiler or Section 1 boiler piping.

ASME SEC 8, D-1 for other relief valves.

2.9.6 Bolts and Nuts

a. Bolts: ASTM A193/A193M, Grade B8. Lengths of bolts shall be such that not less than two full threads will extend beyond the nut with the bolts tightened to required tensions and washers seated.

b. Nuts: ASTM A194/A194M, Grade 8, Type 304 stainless steel, heavy hex nut, ASME B 18.2.2.

c. Washers: Type 304 stainless steel.

2.9.7 Gaskets

Provide fullface gaskets with flat-faced flanges. Raised face and flat faced flanges shall have gaskets with an outside diameter extending to the inside of the bolt holes. Gaskets shall have an inside diameter equal to or larger than the port opening. Dimensions for spiral wound metallic gaskets shall be in accordance with ASME B16.20. Dimensions for nonmetallic gaskets shall be in accordance with ASME B16.21. Materials for flange gaskets shall be as listed below for design temperatures specified on drawings:

a. Fluid over 180 degrees F and over 150 psig: Spiral wound metal with Type 304 stainless steel metal winding strip and flexible graphite filler, Flexitallic Style CG or equal. .

b. Fluids below 180 degrees F and below 150 psig: Red rubber, J-M Style 107 or equal. .

c. Compressed Air: Spiral wound metal as specified for fluid over 180 degrees F.

2.9.8 Expansion Joints

2.9.8.1 Bellows Expansion Joints

ASTM F 1120 flexible guided type with stainless steel expansion element, internal sleeves and external covers. Joints shall be designed for a working pressure of 150 psig and a temperature of 275 degrees F.

2.9.9 Pipe Hangers and Supports

MSS SP-58, Adjustable type, except as specified or indicated otherwise on design drawings. Suspended steam and condensate piping shall have pipe hangers with insulation protection saddles . Provide insulated piping,

except steam and condensate piping, with insulation protection shields Type 40. Provide bronze or copper plated collars on uninsulated copper piping. Support rods shall be steel. Rods, hangers and supports shall be zinc plated, except for uninsulated copper piping which shall be copper plated; cast iron rollers, bases and saddles may be painted with two coats of heat resisting aluminum paint in lieu of zinc plating. Axles for cast iron rollers shall be stainless steel. Size hanger rods with a 150 percent safety factor for a seismic design.

2.9.10 Instrumentation

See Section 40 95 00 PROCESS CONTROL for instrumentation.

2.9.11 Miscellaneous Pipeline Components

2.9.11.1 Air Traps

Float controlled valves arranged to close properly when water enters the traps. Air traps shall conform to the requirements for float operated steam traps (non-thermostatic), CID A-A-60001, except that the valve mechanism shall be inverted so as to be closed, not opened, by rising water.

2.9.11.2 Steam Traps

CID A-A-60001. Cast steel thermodynamic high pressure steam traps designed for use at 600 psig at 800 degrees F. Low pressure steam traps shall be float and thermostatic type for pressures up to 15 psig. Provide traps with separate strainers unless specified otherwise.

2.9.11.3 Strainers

FS WW-S-2739, Style Y with blow off outlet. Construct strainers for Class 600 of cast carbon steel in accordance with ASME B16.5 for minimum of 984 psig saturated steam pressure. Provide blow off outlet with pipe nipple and gate valve.

2.9.12 Insulation Types and Installation Procedures

Materials and application shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.9.13 Pipe Sleeves

2.9.13.1 Floor Slabs, Roof Slabs, and Outside Walls Above and Below Grade

Galvanized steel pipe having an i.d. at least 1/2 inch larger than the o.d. of the pipe passing through it. Provide sufficient sleeve length to extend completely through floors, roofs, and walls, so that sleeve ends are flush with finished surfaces except that ends of sleeves for floor slabs shall extend 1/2 inch above finished floor surface. Sleeves located in waterproofed construction shall include flange and clamping ring.

2.9.13.2 Partitions

Galvanized sheet steel, 26 gage or heavier, of sufficient length to completely extend through partition thickness with sleeve ends flush with partition finished surface.

2.9.14 Piping Identification

Conform to MIL-STD-101 and place in clearly visible locations; except that piping in the boiler room shall be painted the primary color of the color code. Labels and tapes conforming to ASME A13.1 shall be used in lieu of band painting or stenciling. Labels shall be outdoor grade acrylic plastic. Markings on the labels shall indicate the direction of flow, flowing media, and media design pressure and temperature. Spacing of identification marking shall not exceed 10 feet. Provide two copies of the complete color and stencil codes used. Frame codes under glass and install where directed.

2.10 MARKING

Identify equipment, valves, switches, motor controllers, and controls or indicating elements by printed, stamped or manufactured identification plates or tags of rigid plastic or non-ferrous material. Lettering for identification plates or tags shall be not less than 3/16 inch high. Nomenclature and identification symbols used on identification plates or tags shall correspond to those used in the maintenance manuals, operating instructions, instrument and control diagrams, and schematic diagrams. Rigidly affix identification plates or tags to equipment or devices without impairing functions or, when this is not possible, attach using a non-ferrous wire or chain. In addition to the identification plate or tag, each major component of equipment shall have a nameplate listing the manufacturer's name, model number, and when applicable, electrical rating and other information required by pertinent standards or codes.

2.11 TOOLS AND TESTING EQUIPMENT

Provide special tools and wrenches required for the installation, maintenance, and operation of the equipment. Provide testing equipment necessary to perform routine tests:

a. On lubricating oil for acidity (pH-potentiometer), viscosity (saybolt test), and dirt (gravimetric).

b. On softened water for hardness (soap test or colorimetric test), and boiler blowdown water for pH (colorimetric) and conductivity (potentiometer).

2.12 WELDING MATERIALS

Comply with ASME BPVC SEC II-C. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures. See Section 40 17 26.00 20 WELDING PRESSURE PIPING.

2.13 MOTORS AND DRIVES

Alternating current electric motors shall meet requirements of NEMA MG 1. Motors shall be designed for continuous operation at rated load under usual service conditions as defined by NEMA. Motors less than 1 hp shall meet NEMA High Efficiency requirements. Motors 1 hp and larger shall meet NEMA Premium Efficiency requirements. Unless specifically noted otherwise, motors less than 1/2 hp shall be 115 volt, 60 Hz, single phase, capacitor-start, or permanent split capacitor, with Class B insulation for 104 degrees F ambient. Unless specifically noted otherwise, motors 1/2 hp and larger shall be 460 volt, 60 Hz, three phase, Design B, squirrel cage

induction with a minimum insulation of Class F for 104 degrees Fambient. Size motors to meet the power requirements of the driven unit at design conditions, including drive and coupling losses which are incurred, without loading the motor beyond its nameplate power rating. Minimum service factor for open drip-proof motors shall be 1.15 and for totally enclosed, fan cooled motors 1.0. Motor shall be quiet operating. Bearings shall be heavy duty, grease lubricated, anti-friction, single shielded, regreasable type and shall have approved lubricating fittings extended to an easily accessible location for field servicing. Provide sole plates for motors installed on concrete pads. Motors shall have copper windings.

Motors for use with variable frequency drives shall be inverter ready per NEMA MG 1 Part 30.

2.14 SOURCE QUALITY CONTROL

2.14.1 Plant Equipment Tests

Tests specified below shall be conducted at factory prior to delivering equipment to job site.

2.14.1.1 Variable Speed Motor Controller Factory Test

Burn-in tests shall be conducted for at least 50 hours at rated conditions. If a component fails during the burn-in test it shall be replaced, and the entire test shall be run again on the complete assembly for another 50 hours. The burn-in test shall not be complete until the entire assembly has operated for 50 hours without failure.

PART 3 EXECUTION

3.1 INSTALLATION

Install materials and equipment as indicated and in accordance with manufacturer's recommendations.

3.1.1 Equipment Installation

Install equipment in accordance with this specification, and the installation instructions of the manufacturers. Equipment mounted on concrete foundations shall be grouted before installing piping. Install piping in such a manner that it will not impart a stress on equipment. Flanged joints shall not be bolted tight unless they match adequately. Expansion bends shall be adequately extended before installation. Support, grade, anchor, and guide all piping so that there are no low pockets, which could accumulate fluids, along the piping run.

3.1.1.1 Equipment Foundations

Equipment foundations shall be of sufficient size and weight, and proper design to prevent shifting of equipment under operating conditions, or under abnormal conditions which could be imposed upon equipment. Equipment vibration shall be limited within acceptable limits, and isolated. Foundations shall be adequate for soil conditions of the site and shall meet requirements of the equipment manufacturer. Trowel exposed foundation surfaces smooth except when properly roughened surfaces are necessary to receive grout.

3.1.1.2 Forced Draft Fan

Fan assembly shall be set, shimmed level, anchored and grouted in place prior to setting driver. Driver shall be properly shimmed on base plate using steel shim stock. Shims shall be full size of feet and shall have a slotted hole for installation. After the drive has been properly aligned and shimmed, by an approved millwright, the millwright shall drill and ream the foot and base plates and, install taper pins with nut on top for pullout removal. One front foot and diagonally opposite rear foot shall be pinned to base plate. Bolt equipment into place in an approved manner. Level and grout the fan and bearing pedestal sole plates into place.

3.1.1.3 Stack

Install, level and plumb. Erected stack shall be no more than one inch out of plumb (out of vertical) per 50 feet. Remove roughness, marks, and lifting lugs, from stack and grind surfaces smooth and flush with surrounding surfaces.

3.1.2 Piping

Unless specified otherwise, erection, testing and inspection of piping shall be in accordance with applicable design code as scheduled on drawings. See drawings for design and analysis. See Section 40 17 26.00 20 WELDING PRESSURE PIPING for welding. Piping shall follow the general arrangement shown. Cut piping accurately to measurements established for the work. Work piping into place without springing or forcing, except where cold-springing is specified. Piping and equipment within buildings shall be entirely out of the way of lighting fixtures and doors, windows, and other openings. Locate overhead piping in buildings in the most inconspicuous positions. Do not bury or conceal piping until it has been inspected, tested, and approved. Where pipe passes through building structure, pipe joints shall not be concealed, but shall be located where they may be readily inspected and building structure shall not be weakened. Avoid interference with other piping, conduit, or equipment. Except where specifically shown otherwise, vertical piping shall run plumb and straight and parallel to walls. Install piping connected to equipment to provide flexibility for vibration. Support and anchor piping so that strain from weight of piping is not imposed on equipment.

3.1.2.1 Fittings

Provide long radius elbows on welded piping to reduce pressure drops. Do not miter pipe to form elbows, notch straight runs to form full sized tees, or use similar construction. Make branch connections with welding tees, except factory made forged welding branch outlets or nozzles having integral reinforcements conforming to applicable design code as scheduled on drawing may be used.

3.1.2.2 Grading of Pipe Lines

Unless indicated otherwise, install horizontal lines of steam and return piping with uniform grade down in the direction of flow with a pitch of not less than one inch in 30 feet, except in loop mains and main headers where flow may be either direction. Pitch air lines to the source of supply, and make provisions for draining off condensate. Install water lines to drain to a shutoff valve.

3.1.2.3 Anchoring, Guiding, and Supporting Piping

Anchor and support piping in a manner such that expansion and contraction will take place in the direction desited, prevent vibration by use of vibration dampeners, and prevent undue strains on boilers and equipment served. Fabricate hangers used for support of piping of 2 inch nominal pipe size and larger to permit adequate adjustment after erection while still supporting the load. Provide wall brackets where pipes are adjacent to walls or other vertical surfaces which may be used for supports. Provide supports to carry weight of lines and maintain proper alignment. Provide inserts and sleeves for supports in concrete where necessary and place in new construction before pouring concrete. Provide insulated piping with a pipe covering protection saddle at each support. Provide pipe guides and anchors of approved type at points where necessary to keep pipes in accurate alignment, to direct expansion movement, and to prevent buckling and swaying and undue strain. Provide pipe guides for alignment of pipe connected to free unanchored end of each expansion joint. Support pipe rollers in concrete conduits and trenches by extra strong steel pipe with ends inserted in slots provided in concrete walls. Set pipe supports for rollers at correct elevations either by metal shims or by cutting away of concrete and after placing pipe lines in alignment, grout ends of pipe supports and fix in place. Space pipe supports to provide adequate support for pipes. Pipe shall not have pockets formed in the span due to sagging of pipe between supports, caused by weight of pipe, medium in pipe, insulation, valves, and fittings. Maximum spacing for pipe supports for steel pipe shall be in accordance with criteria noted on the drawings.

3.1.2.4 Sleeves

Provide pipe sleeves where pipes and tubing pass through masonry and concrete walls, floors, and partitions. Space between pipe, tubing, or insulation and the sleeve shall be not less than 1/4 inch. Hold sleeves securely in proper position and location before and during construction. Sleeves shall be of sufficient length to pass through entire thickness of walls, partitions, and slabs. Sleeves in floor slabs shall extend 1/2 inch above the finished floor. Firmly pack space between pipe or tubing and the sleeve with oakum and caulk on both ends of the sleeve with elastic cement.

3.1.2.5 Flashing for Buildings

Where pipes pass through building roofs and outside walls, provide proper flashing and counter flashing and make tight and waterproof.

3.1.2.6 Outlets for Future Connections

Locate as directed capped or plugged outlets for connections to future equipment, when not located exactly by the project drawings.

3.1.2.7 Screwed Joints in Piping

Provide Teflon tape or suitable pipe joint compound applied to male threads only for making up screwed joints. Piping shall be free from fins and burrs. Ream or file out pipe ends to size of bore, and remove chips.

3.1.2.8 Welds and Welded Joints

Weld piping in accordance with Section 40 17 26.00 20 WELDING PRESSURE PIPING.

3.1.2.9 Cleaning of Piping

Before installing pipe, thoroughly clean it of sand, mill scale and other foreign material. After erection but before final connections are made to apparatus thoroughly clean the interior of piping. Flush with water piping except air and fuel lines, in addition, blow out steam lines with intermittent high pressure steam blows to promote shedding of internal scale. Blow compressed air lines clean with 80 to 100 psig air dried to a 35 degree F dew point at 80 psig. Sterilize potable water piping by means of liquid chlorine or hypochlorite in accordance with AWWA C651 before placing water system in service. Take care during fabrication and installation, to keep piping, valves, fittings and specialties free of loose welding metal chips of metal or slag, welding rods and other foreign matter. Blowing or flushing shall in no case be channeled through equipment, pump, control valve, regulating valve, instrument gage or specialty in the system. Provide temporary screens, strainers, connections, spool pieces and bypasses consisting of piping or hoses, pumps and other required equipment temporarily installed for the purpose of cleaning and flushing piping. Drain flushing water and test water to the sanitary sewer system.

3.1.2.10 Reduction in Pipe Size

Provide reducing fittings for changes in pipe size; the use of bushings will not be permitted. In horizontal steam lines, reducing fittings shall be the eccentric type to maintain the bottom of the lines in the same plane. In horizontal water mains, reducers shall be set to maintain the top of the lines in the same plane.

3.1.2.11 Expansion Control

Provide bends, loops, and offsets wherever practical to relieve overstressed piping systems due to thermal expansion and to provide adequate flexibility. Cold spring piping system as indicated but not more than 50 percent of the total linear expansion.

3.1.2.12 Connection to Equipment

Provide unions or flanges where necessary to permit easy disconnection of piping and apparatus. Provide unions and gate valves at each connection to threaded end control valves, strainers and equipment.

3.1.2.13 Valve Installation

Install valves in positions accessible for operation and repair. Install stems in a vertical position with handwheels or operators on top or in a horizontal position. Do not install handwheels on stop valves below the valve. When centerline of valve is more than 7 feet above floor or platform, provide valve with a chain-operated handwheel. When valve is motorized, provide hand operation for emergency use.

a. Globe Valves: Pressure shall be below the disc. Install globe valves with the stems horizontal on steam and exhaust lines, when better drainage is required or desited.

b. Steam Pressure-Reducing Valves: Provide the steam line entering each pressure-reducing valve with a strainer. Provide each pressure-reducing valve unit with two shutoff valves and with a globe or angle bypass valve and bypass pipe. A bypass around a reducing

valve shall be of reduced size to restrict its capacity to approximately that of the reducing valve. Provide each pressure-reducing valve unit with indicating steam gages to show the reduced pressure and the upstream pressure and an adequately sized safety valve on the low pressure side.

c. Valve Tags and Charts: Permanently tag each valve with a black and white engraved laminated plastic tag showing valve number, valve function and piping system and whether another valve must be opened or closed in conjunction with this valve. Provide a typed chart which will show the required valve tagging plus the location of each valve. Frame valve charts under glass and install as directed.

3.1.2.14 Traps and Connections

Traps shall be of the type and capacity for the service required, and shall be properly supported and connected. Install traps with a dirt pocket and strainer between it and the piping or apparatus it drains. When it is necessary to maintain in continuous service apparatus or piping which is to be drained, provide a three valve bypass so that trap may be removed and repaired and condensate drained through the throttled bypass valve. Provide a check valve on discharge side of trap whenever trap is installed for lift or operating against a back pressure, or it discharges into a common return line. Provide test connections on discharge side of high pressure traps when they are specifically required. Test connection shall include a 1/2 inch globe valve with open blow.

3.1.2.15 Pressure Gage Installation

Provide with a shutoff valve or petcock between the gage and the line, and gage on steam lines shall have a siphon installed ahead of the gage.

3.1.2.16 Thermometer and Sensing Element Installation

Provide thermometers and thermal sensing elements with a separable socket. Install separable sockets in pipe lines in such a manner to sense flowing fluid temperature and minimize obstruction to flow.

3.1.2.17 Strainer Locations

Provide strainers with meshes suitable for the services upstream of each control valve and where dirt might interfere with the proper operation of valve parts, orifices, or moving parts of equipment.

3.1.2.18 Dissimilar Piping Materials

Provide dielectric unions or flanges between ferrous and nonferrous piping, equipment, and fittings, except that bronze valves and fittings may be used without dielectric couplings for ferrous-to-ferrous or nonferrous-to-nonferrous connections. Dielectric fittings shall utilize a nonmetallic filler which will prevent current flow from exceeding one percent of the short circuit current. Spacer shall be suitable for the pressure and temperature of the service. Fittings shall otherwise be as specified in this section.

3.1.3 Painting

3.1.3.1 Piping, Fittings, and Mechanical and Electrical Equipment

Equipment shall be factory finished to withstand the intended end use environment in accordance with the specifications for particular end item. Factory finished equipment on which the finish has been damaged shall have damaged areas retouched and then be given a complete finish coat to restore the finish to its original condition. Finish coat shall be suitable for exposure in the intended end use environment.

3.1.3.2 Other Items

Unless specified otherwise, pipe hangers, structural supports, pipe and pipe fittings, conduit and conduit fittings, air grilles, pipe coverings, insulation, breeching and stacks, forced draft ductwork, and metal surfaces associated with mechanical and electrical equipment including zinc-coated steel ducts shall be painted utilizing the painting systems as specified in Section 09 90 00 PAINTS AND COATINGS. For breeching and stacks, paint shall be shop-applied and of color to match exterior metal roof panels specified in 09 06 90 COLOR SCHEDULE. Zinc-coated steel duct in concealed areas shall not be painted. Except zinc-coated and copper pipe, give piping to be insulated, a protective coating prior to installing insulation.

3.1.3.3 Boilers

After erecting and testing boilers, clean exposed surfaces of the boiler normally painted in commercial practice to remove grease and other foreign matter and finish with one coat of aluminum heat resisting paint applied to minimum dry film thickness of one mil.

3.1.3.4 Surfaces Not to be Painted

Unless specified otherwise, do not paint equipment having factory applied permanent finish, switchplates and nameplates, motor starters, and concrete foundations.

3.1.4 Insulation

Insulate mechanical equipment, systems and piping as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2 FIELD QUALITY CONTROL

Provide labor, equipment, test apparatus and materials required for preparation and performance of tests and inspections specified to demonstrate that the boilers and auxiliary equipment as installed are in compliance with contract requirements. During startup and during tests, factory trained engineers or technicians employed by the boiler manufacturer and system suppliers or manufacturers of such components as the boiler, burner, forced draft fan, feedwater treatment equipment, and other auxiliary equipment shall be present, to ensure the proper functioning, adjustment, and testing of the individual components and systems. The Government will furnish, when available, water, electricity and fuel for the tests, except fuel required for retesting. The Contractor shall rectify defects disclosed by the tests and retest the equipment. The Contractor's boiler plant personnel shall be experienced in starting up and operating boiler plants.

3.2.1 Tests and Inspections (Piping)

3.2.1.1 General Requirements

Examine, inspect, and test piping in accordance with governing design code as scheduled on drawing, except as modified below. The Contractor shall rectify defects disclosed by the tests. Necessary subsequent tests required to prove system tight after additional work by the Contractor shall be provided by the Contractor. Make tests under the direction of and subject to the prior approval of the COR.

3.2.1.2 Hydrostatic and Leak Tightness Tests

a. Test piping systems attached to the boilers and included under the jurisdiction of the ASME BPVC SEC I in accordance with the requirement of that Code. Piping bearing ASME Code symbol stamp will be accepted only as indicating compliance with the design and material requirements of the code.

b. Test piping which is a part of the steam generation or auxiliary systems, including piping within the boiler room and external to the boiler room, by the following methods:

    1. Perform hydrostatic test at 150 percent of design pressure, as adjusted for design temperature per the applicable piping code, for welded and screwed steel piping systems except those for air, and gas. Hold hydrostatic tests for a period of one hour with no pressure loss. Temperature of the testing fluid shall not exceed 100 degrees F.

    2. Test air lines in accordance with the requirements of ASME B31.9 with the exception that the test pressure must be held for one hour. Examination for leaks by a soap or other foaming agent test.

    3. Inspection and test of gas piping shall conform to the requirements of NFPA 54.

c. For tests install a calibrated test pressure gage in the system to observe loss in pressure.

3.2.2 Preliminary Operation

The Contractor under the direction of the respective manufacturer's representative shall perform the work of placing into operation equipment provided except as specifically noted otherwise. Make adjustments to equipment that are necessary to ensure proper operation as instructed by the manufacturer of the equipment.

a. Lubricate equipment prior to operation in accordance with the manufacturer's instructions. Lubricants shall be provided by the Contractor. Contractor shall furnish lubrication gun with spare cartridges of lubricant to operating personnel.

b. Dry out motors before operation as required to develop and maintain proper and constant insulation resistance.

c. Check drive equipment couplings for proper alignment at both ambient and operating temperature conditions.

3.2.3 General Startup Requirements

Prior to initial operation of any complete system, check each component as follows:

a. Inspect bearings for cleanliness and alignment and remove foreign materials found. Lubricate as necessary and in accordance with manufacturer's recommendations. Replace bearings that run roughly or noisily.

b. Adjust direct drives for proper alignment of flexible couplings. Provide lubrication when a particular coupling so requires. Check security of couplings to driver shafts. Set drive components to ensure free rotation with no undesirable stresses present on the coupling of attached equipment.

c. Check motors for amperage comparison to nameplate value. Correct conditions that produce excessive current flow and that exist due to equipment malfunction.

d. Check speeds of each motor and driven apparatus to ensure that they are operating at the desited point.

e. Check actual suction and discharge pressure of each pump against desite d performance curves.

f. Check pump packing glands or seals for cleanliness and adjustment before running each pump. Inspect shaft sleeves for scoring and proper placement of packing; replace when necessary. Ensure piping system is free of dirt and scale before circulating liquid through pumps.

g. Inspect both hand and automatic control valves. Clean bonnets and stems, tighten glands to ensure no leakage, but permit valve stems to operate without galling. Replace packing in valves that require same to retain maximum adjustment after system is judged complete. Replace entire packing in valves that continues to leak after adjustment. Remove and repair bonnets that leak. Coat packing gland threads and valve stems with a suitable surface preparation after cleaning.

h. Inspect and make certain that control valve seats are free from foreign material and are properly positioned for the intended service.

i. Check flanges and packing glands after the system has been placed in operation. Replace gaskets in flanges that show signs of leakage after tightening.

j. Inspect screwed joints for leakage and remake each joint that appears to be faulty. Do not wait for rust to form. Clean threads on both parts, apply compound and remake joint.

k. Strainers installed shall be thoroughly blown out through individual valved blow-off connection on each strainer prior to placing in operation.

l. Thoroughly blow out or dismantle and clean strainers after systems have been in operation one week. Thoroughly clean, repair, and place back in service traps or other specialties in which foreign matter has accumulated, causing malfunction or damage.

m. Adjust pipe hangers and supports for correct pitch and alignment.

n. Remove rust, scale and foreign materials from equipment and renew defaced surfaces. When equipment is badly marred, the COR shall have the authority to request that new materials be provided.

o. Adjust and calibrate temperature, pressure and other automatic control systems.

p. Inspect each pressure gage and thermometer for calibration, and replace those that are defaced, broken or read incorrectly.

3.2.4 Boilers and Auxiliaries Tests and Inspections

The Contractor, with qualified personnel provided by the Contractor, shall make tests and inspections at the site under direction of and subject to approval of the COR. The respective manufacturer's representatives and consultants shall direct the Contractor's boiler plant personnel in the operation of each boiler and appurtenances through the entire testing period and shall ensure that necessary adjustments have been made. The Contractor shall notify the COR in writing, at least 7 days in advance, indicating that equipment is ready for testing. The Contractor shall provide testing equipment, including gages, thermometers, calorimeter, flue gas analyzers, thermocouple pyrometers, fuel flow meters, water meters and other test apparatus and calibrate instruments prior to the test. Draft, fuel pressure and steam flow may be measured by permanent gages and meters installed under the contract. The Contractor is responsible for providing an analysis of the fuel being used for the tests. Control of noise levels developed by exhaust steam shall be as directed by the COR to satisfy environmental conditions of the surrounding area. The Contractor shall perform the following tests in the sequence as listed when feasible:

a. Strength and tightness tests

b. Standards compliance tests

c. Preliminary operational tests (steady state combustion test and variable load combustion test)

d. Tests of auxiliary equipment

e. Feedwater equipment test

f. Capacity and efficiency tests

3.2.4.1 Strength and Leak Tightness Tests

Subject boilers to the following strength and tightness tests:

a. Watersides Including Fitting and Accessories: Hydrostatically test watersides in accordance with the requirements of the ASME BPVC SEC I. Since damage to the boiler components may have occurred during shipping, the factory ASME label will not be accepted as evidence of this test. Therefore, the final hydrostatic test must be performed after the installation of the boiler and its auxiliary components have been installed.

b. Boiler Casing, Air Casing, and Ducts: Test air casing and ducts exterior to the furnace pneumatically at the maximum working pressure.

Use the soap bubble method to verify tightness. Test gas sides of boilers normally operated under pressure for tightness at one and one half times the predicted operating pressure in the furnace at maximum continuous output. For this test, tightly seal the boiler with a suitable means to blank off openings. Admit air to the boiler until the test pressure is reached, and then hold. If in a 10 minute period the pressure drop does not exceed 5 inches water gage, the casing shall be regarded as tight and accepted.

3.2.4.2 Boiler Inspection

The Boiler Inspector shall be on hand to witness the appropriate tests which need to be observed in order to certify the safety of the boiler. The inspection shall be in accordance with NBBI NB-23 . The Boiler Inspector shall complete required forms and Inspection Report; and Inspection Certificate for each boiler after boiler has been inspected and found to be safe. No boiler may be fired until it has passed the inspection of the Boiler Inspector. Boiler inspection forms shall be submitted through the Contractor to the COR. Place Inspection Certificate under framed glass, mounted on or near the boiler in a conspicuous location as directed by COR.

3.2.4.3 Boiler Cleaning and Startup

Dry out, boil out, and operate firing rate of new boilers under direct responsibility and supervision of the manufacturer, and in the presence of boiler room operating personnel. Provide required chemicals. Allow sufficient time for boiling out process to ensure interior surfaces are clean. This time shall be at least 24 continuous hours and generally not more than 36 hours; boil out shall continue until water is clear. Boil out, cleaning and starting procedures shall be in accordance with requirements of ASME BPVC SEC VII and FM DS 12-17.

3.2.4.4 Boiler Preliminary Operational Tests

Conduct a boiler operational test on each unit continuously for two weeks. Operate one boiler at a time to demonstrate control and operational conformance to specified requirements including ability to respond to load swings from the specified capacity to minimum turndown. Conduct operational test under the supervision of a professional engineer registered in the State of California or a licensed power plant operator and demonstrate operation of safeties, controls, maintenance of stable combustion at low loads, proper flame lengths and patterns to avoid flame impingement on the tubes for gas firing, and proper mechanical and electrical functioning of systems. This test shall include items mentioned in this specification as well as items mentioned in the specification of the particular pieces of equipment. Conduct tests with factory trained combustion equipment engineers as previously specified. Test and record steam quality, steam flowrates, flue gas temperature, percentages of carbon dioxide, carbon monoxide, oxygen and nitrogen in the flue gas and percent excess air for each boiler at tested load and graphically present test data.

3.2.4.5 General Controls Operational Tests

Conduct operational tests, performance tests, and demonstration tests with boiler controls functional and on line. No bypassing, use of jumpers, or other disablement of control systems will be allowed unless specified elsewhere.

3.2.4.6 Steady State Combustion Tests

Test fuel burning and combustion control equipment with each of the specific fuels at the minimum limit of the turndown range and at increments of 50, 75 and 100 percent of full rated load. Each test run shall be at least two hours on each fuel and until stack temperatures are constant and capacity and efficiency requirements of this specification have been verified and recorded. Verify proper operation of instrumentation and gages during the tests.

3.2.4.7 Varying Load Combustion Tests

Test boilers continuously under varying load conditions to demonstrate proper operability of the combustion control, flame safeguard control, programming control and safety interlocks. Conduct these tests after the adjustment of the combustion controls has been completed under the steady state combustion tests. Continue the variable load operational tests for a period of at least 8 hours.

a. Sequencing: Boiler shall start, operate and stop in strict accordance with the specified operating sequence.

b. Flame Safeguard: Verify operation of flame safeguard controls by simulated flame and ignition failures. Verify the trial-for-pilot ignition, trial-for-main flame ignition, combustion control reaction and valve closing times by stop watch.

c. Immunity to Hot Refractory: Operate burner at high fire until combustion chamber refractory reaches maximum temperature. Main fuel valve shall then be closed manually. Combustion safeguard shall drop out immediately causing safety shutoff valves to close within the specified control reaction and valve closing times.

d. Boiler Limit and Fuel Safety Interlocks: Safety shutdown shall be caused by simulating interlock actuating conditions for each boiler limit and fuel safety interlock. Safety shutdowns shall occur in the specified manner.

e. Combustion Controls: Demonstrate accuracy, range and smoothness of operation of the combustion controls by varying the steam demand through the entire firing range required by the turndown ratio specified for the burner. Control accuracy shall be as specified.

f. Safety Valves: High pressure limit switch shall be locked out or otherwise made inoperative and the boiler safety valves shall be lifted by steam. Determine the relieving capacity, popping pressure, blowdown and reseating pressure by observation and measurement in accordance with the ASME BPVC SEC I. The ASME standard symbol will be accepted only as indicating compliance with the design and material requirements of the code.

3.2.4.8 Auxiliary Equipment and Accessory Tests

Observe and test blowdown valves, stop valves, try cocks, fans, pumps, electric motors, and other accessories and appurtenant equipment during operational and capacity tests for leakage, malfunctions, defects, and for compliance with referenced standards.

3.2.4.9 Feedwater Equipment Tests

Perform tests of feedwater treatment equipment in two steps. Conduct one test concurrently with the combustion tests. The Government will perform a second test during the first period of heavy loading after plant has been accepted and put in service. Correct deficiencies revealed during the Government tests under the guarantee provisions of the contract. Both the first and second series of tests shall determine compliance with limits for chemical concentrations of this specification. Supply equipment for taking samples and test kit for analyzing samples. Sampling equipment and test kit shall become the property of the Government when tests are completed.

3.2.4.10 Capacity and Efficiency Tests

Perform capacity and efficiency tests after satisfactorily completing operating tests and after operating boiler continuously for at least 14 days with no nuisance shutdowns and without the necessity for frequent or difficult adjustments. Perform these tests on each boiler. Conduct tests using the specified fuel. Test procedures shall be in accordance with the heat loss method of ASME PTC 4. Before tests are performed, the COR and the Contractor shall reach agreement on those items identified in ASME PTC 4, Section 3, paragraph 3.0l "Items on Which Agreement Shall be Reached." A test run shall not start until boiler and accessories have reached an equilibrium and stabilization condition for at least one hour in duration. Duration of tests shall be sufficient to record necessary data but in no case shall each run be less than 4 hours.

3.2.4.11 Test Runs

Accomplish maximum output testing by means of a single 2 hour run at 110 percent load on the boiler under test. Calculate boiler efficiency, using the heat loss method, from the consistent readings taken during the runs. Make runs at four different loads 30, 50, 70, and 100 percent of boiler rating during which take both heat loss and input-output data. Predict unmeasured losses used in conjunction with heat loss calculations and include with equipment data when submitted for approval. Subsequent tests required because of failure of equipment to perform adequately during specified capacity and efficiency tests shall be financial responsibility of the Contractor, including fuel cost.

3.2.4.12 Fuel Analysis

When analysis of fuel being burned during performance tests vary from that specified as the performance fuel the guarantees shall be adjusted in accordance with accepted engineering practice to determine compliance. Carbon loss shall be determined in accordance with ABMA Boiler 103, American Boiler Manufacturers Association curves for carbon loss.

3.2.4.13 Temporary Waste Steam Connection

When necessary to obtain sufficient load for these tests, provide a temporary steam line at a point outside of the building. Provide necessary pipe, fittings, supports, anchors and appurtenances including a field fabricated silencer as directed by the COR. Remove temporary piping and silencer after tests have been satisfactorily completed.

3.2.4.14 Plant Acceptance Operation

After satisfactory completion of tests specified, operate the complete

plant including each boiler, its related flue gas cleaning equipment and subsystems for a period of 30 continuous 24 hour operational days prior to final acceptance by the Government. Furnish labor, chemicals, test equipment and apparatus; the Government will furnish fuel, electricity and water. During this 30 day period, furnish readily available, the services of qualified representatives from manufacturers of plant components and systems for the purpose of additional operational assistance, component and system adjustment and repairs. Government personnel will observe Contractor's operational procedures. The Contractor's representatives shall be prepared to answer pertinent questions from the Government, about the plant operation.

3.2.5 Manufacturer's Field Services

3.2.5.1 Erection/Installation Supervisors and Service Engineers

a. Boiler: Furnish the services of a competent supervisor who is in the direct employ of the boiler manufacturer. This supervisor shall remain on the construction site the full 8 hours per day, 5 days per week, or the same hours, that the boiler installation takes place. This supervisor shall be responsible for the complete steam generating unit, including the steam generator, forced draft fan, burner and other related work, such as refractory, or insulation regardless of whether the forced draft fan, burner or the other related items of work are furnished by manufacturers other than the boiler manufacturer.

b. Forced Draft Fans: The Contractor shall furnish a company service engineer to advise on the erection or installation of fans and related equipment.

c. Service Engineers: Services of the manufacturing companies' service engineers and the system suppliers' service engineers shall be provided by the Contractor to advise during erection and installation of other systems and equipment such as air compressors, boiler feedwater pumps, water treatment equipment, chemical feed pumps, deaerating feedwater heater and stacks.

3.2.5.2 Boiler and System Representatives

a. Furnish factory trained engineers or technicians who are representatives of the boiler manufacturer and system suppliers to supervise testing of the boilers and auxiliary equipment.

b. Furnish the services of a Boiler Inspector who is qualified and certified as such by the National Board of Boiler and Pressure Vessel Inspectors and who is presently employed full time by a firm, such as Hartford Steam Boiler Inspection and Insurance Company, which has a business of inspecting boilers.

3.2.5.3 Instruction to Government Personnel

In accordance with the provisions of Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, supervisors and service engineers shall provide instruction for the Government's operators in the operation and maintenance of the equipment furnished under this section. The minimum number of hours of instruction provided shall be as follows:

Equipment	Operation Instruction	Maintenance Instruction
Boiler and auxiliaries	8 hours	8 hours
Forced draft fans	4 hours	4 hours
Fuel system	4 hours	4 hours
Boiler feedwater pumps	8 hours	8 hours
Miscellaneous equipment	8 hours	8 hours

3.3 WASTE MANAGEMENT

Separate waste in accordance with the Waste Management Plan, placing copper materials and ferrous materials in designated areas for reuse. Close and seal tightly all partly used adhesives and solvents; store protected in a well-ventilated, fire-safe area at moderate temperature.

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SECTION 23 52 49.00 20

AUXILIARY STEAM BOILER

PART 1 GENERAL

1.1 SUMMARY

This section covers steam boilers and related equipment for capacities from 150 to 5275 kW 500,000 to 18,000,000 Btu/Hr.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S1.4	Specification for Sound Level Meters (ASA 47)

AMERICAN WELDING SOCIETY (AWS)

AWS Z49.1	Safety in Welding and Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

ASME B40.100	Pressure Gauges and Gauge Attachments
ASME CSD-1	Control and Safety Devices for Automatically Fired Boilers
ASME PTC 4	Fired Steam Generators

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-50562	Pump Units, Centrifugal, Water, Horizontal; General Service and Boiler-Feed: Electric-Motor or Steam-Turbine-Driven

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards

1.3 SYSTEM DESCRIPTION

Describe the performance or design requirements and tolerances of the

boiler system.

1.3.1 Heating Surface and Volume Measurements

Submit heating surface and volume measurements, including heat release calculations and performance data at minimum, 25 percent, 50 percent, 75 percent, and 100 percent load sufficient to establish compliance of boilers with heat release requirements. Base calculations on the specified efficiency and capacity.

1.4 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS applies, with the additions and modifications stated herein.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Steam boiler system

SD-05 Design Data

Heating surface and volume measurements

Heat release calculations

Performance data at minimum, 25 percent, 50 percent, 75 percent, and 100 percent load

SD-06 Test Reports

Boiler system start-up tests

Submit test reports in accordance with section entitled "Field Quality Control." Submit a detailed written record of the start-up performance, including burner setting data over the entire load range, before the Contractor's and sub-contractor's test personnel leave the site.

SD-07 Certificates

Report of prior installations

Qualifications of engineer

Start-up plan

Start-up certification

Boilers

Submit evidence that boilers meet requirements of standards specified. Include with the certificate of compliance acceptable evidence that standards are met. Acceptable evidence will be the official UL listing mark prescribed in the UL gas and oil

equipment list for oil-fired, gas-fired, or gas and oil-fired boiler assemblies, as applicable plus the appropriate official ASME symbol stamp. In lieu of the above certification, acceptable evidence will be a test report from an independent testing laboratory, indicating that the boilers and accessories have been inspected and tested and meet requirements of the applicable standards specified.

SD-10 Operation and Maintenance Data

Boilers, Data Package 4

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6 QUALITY ASSURANCE

1.6.1 Report of Prior Installations

Boilers shall be shipped to the site of installation as a completely assembled packaged boiler-burner unit. Boilers and feedwater equipment installed shall be of proven design which has been tested, successfully installed, and operated in commercial or industrial installations. Submit a certified written report from the boiler and feedwater equipment manufacturer indicating date of installation, type, model, capacity, and address location of installed boilers. Show that substantially identical equipment of comparable capacity, within 20 percent, has been successfully installed and operated in not less than three installations under similar operating conditions for a period of not less than 2 years.

1.6.2 Start-Up and Installation Engineer

Provide the services of a qualified engineer or technician for start-up and tests and installation of equipment as specified below. More than one engineer or technician may be employed based on the types of specific equipment. One engineer or technician appointed by the Contractor shall supervise and be responsible for the overall installation, start-up, test, and checkout of systems.

1.6.3 Qualifications of Engineer

Submit a printed certified qualification resume of the engineer or technician. The engineer's or technician's resume shall list applicable experience related to installation, start-up, and testing of equipment and applicable factory training and education. Qualifications require the engineer to have supervised two installations of similar size and type which are operating satisfactorily. If more than one engineer or technician is employed, provide a certified resume for each one indicating their specific specialty and item of work.

1.6.4 Start-Up Plan

Submit a written schedule with dates of start-up tests, installation, and checkout of equipment.

1.6.5 Start-Up and Test

Start-up and test engineer or technician shall be approved by the manufacturer of the specific piece of equipment including boiler, boiler

controls, boiler instrumentation, and feedwater equipment. The start-up and test engineer or technician shall remain on the job until the unit has been in successful operation for 1 day, and has been accepted by the Contracting Officer.

1.6.6 Start-Up Certification

After installation of equipment, the engineer or technician shall submit a signed certificate or certified written statement that the equipment is installed in accordance with the manufacturer's recommendations.

1.6.7 Welding

Structural members shall be welded in accordance with Section 05 12 00 STRUCTURAL STEEL. Welding and nondestructive testing procedures for piping are specified in Section 40 17 26.00 20 WELDING PRESSURE PIPING.

1.7 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

1.8 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings and no later than 2 months prior to the date of beneficial occupancy.

Include in the data a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 years of service.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the COR, reasonably convenient to the site. Submit manufacturer's catalog data included with the detail drawings for the following:

a. Data showing model, size, options, etc., that are intended for consideration. Data submitted shall be adequate to demonstrate compliance with contract requirements. Data shall include manufacturer's written installation instructions and manufacturer's recommendations for operation and maintenance clearances for the following:

    1. Boilers

    2. Fuel Burning Equipment

    3. Combustion Control Equipment

4. Pumps

5. Fittings and Accessories

2.1.2 Asbestos Prohibition

Asbestos and asbestos-containing products will not be allowed.

2.1.3 Nameplates

Secure a plate to each major component of equipment containing the manufacturer's name, address, type or style, model or serial number, and catalog number. Also, display an ENERGY STAR label as applicable. Each pressure vessel shall have an approved ASME stamp.

2.1.4 Equipment Guards

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded in accordance with OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

2.2 AUXILIARY BOILER

Water tube type, except that treatment and painting shall be in accordance with manufacturer's standard practice. Boilers shall have performance as scheduled at the site under design conditions when the burner is firing natural gas having a higher heating value of 1030 Btu per cubic foot and a pressure of 1/4 psig at the fuel train connection. Gas fired boilers shall have a steady state combustion efficiency of at least 80 percent when fired at the maximum and minimum rated capacities which are provided and allowed by the controls. Boilers shall comply with local, state, and federal emission regulations for the fuel being used. Boiler furnaces shall be equipped with combustion control safety devices conforming to ASME CSD-1. Burners of the rotary type are not acceptable. Programming controls shall be of the automatic recycling type and shall incorporate means for automatic self-checking of the circuit at the beginning of each start-up cycle. Include a repetitive self-checking circuit to check components at intervals not to exceed the specified flame failure response time in FS F-B-2910, as applicable, during the entire period of burner operation. Combustion controls, shall be of the on-off type for each stage. Provide connections for remote starting or stopping of the boilers. Boilers shall be manual start.

2.2.1 Boiler Connections

Requirements for interconnecting piping, insulation, fuel supply, and other related work necessary to provide a complete and operable steam system, whether or not specifically mentioned above, shall conform to applicable requirements of other sections of Division 15.

2.2.2 Boiler Instrumentation

In addition to the instruments required by the boiler specifications referenced above, provide the following instruments and locate where shown and where recommended by instrument manufacturer:

a. A flue gas temperature gage.

b. A draft gage, single point, conforming to ASME B40.100.

2.2.3 Auxiliary Boiler Controls and Instruments

2.2.4 Boiler Control and Instrument Cabinet

Provide boiler control and instrument cabinet mounted either on the boiler front or adjacent thereto. The arrangement may consist of a boiler mounted cabinet containing controls normally provided by the manufacturer and a supplementary cabinet containing additional controls and instruments required herein.

2.2.5 Fuel Burning Equipment

Boiler shall be designed to burn gas. Boiler shall comply with Federal, state, and local emission regulations. Boiler shall comply with SCAQMD Rule 1146.2. As a minimum, the following emission requirements shall be met:

NOx - 30 parts per million (ppm) corrected to 3 percent oxygen.

2.2.5.1 Gas Fired Burners and Controls

Burners shall be UL approved mechanical draft burners with all air necessary for combustion supplied by a blower where the operation is coordinated with the burner. Burner shall be provided complete with fuel supply system in conformance with the following safety codes or standards:

Gas-fired units shall conform to UL 795, Factory Mutual (FM) rating, and ANSI Z21.13/CSA 4.9.

2.2.6 Draft Fans

Fans conforming to AMCA 801 forced-draft shall be furnished as an integral part of the boiler design. Fans shall be centrifugal type. Each fan shall be sized for output volume and static pressure rating sufficient for pressure losses, excess air requirements at the burner, leakages, temperature, and elevation corrections for worst ambient conditions, all at full combustion to meet net-rated output at normal firing conditions, plus an overall excess air volume of 10 percent against a 20 percent static overpressure. Noise levels for fans shall not exceed 85 decibels in any octave band at a 3 foot station. Forected draft fan bearings shall be air cooled.

2.2.6.1 Draft Fan Drives

Fans shall be driven by electric motors. Electric motors shall be drip proof. Motor starter shall be magnetic across-the-line type with weather-resistant enclosure and shall be furnished with four auxiliary interlock contacts.

2.2.7 Draft Damper

Boilers shall be provided with manual dampers, draft hoods, or barometric dampers as recommended by the boiler manufacturer to maintain proper draft in the boiler. Draft damper shall be provided in a convenient and accessible location in the flue gas outlet from the boiler. Automatic

damper shall be arranged for automatic operation by means of a damper regulator.

2.2.8 Noise Levels

Noise measurements and exposure analyses should be conducted under the overall supervision of a qualified industrial hygienist . Safety personnel, engineers and others who have been approved by the COR also may supervise the work. Exposure limits for potentially hazardous noise levels of 85 dBA, continuous or intermittent, and 140 dB peak sound pressure, impulse or impact, shall be maintained. The sound level meter shall conform as a minimum to the Type 2 requirements cited in ASA S1.4.

2.3 FEEDWATER EQUIPMENT

2.3.1 Boiler Feed Pump

Conform to CID A-A-50562 for motor driven, boiler feed pumps except as otherwise specified herein. Pumps shall be centrifugal type with cast iron casing and shall be bronze fitted. Mechanical seals suitable for the design conditions indicated shall be provided. Pumps shall be designed for the net positive suction head, discharge head, and water temperature indicated. Capacity under the above condition shall be not less than indicated. Pump motors shall be dripproof.

2.4 ELECTRIC MOTORS

Motors which are not an integral part of a packaged boiler shall be rated for premium efficiency service per Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Motors which are an integral part of the packaged boiler system shall be the highest efficiency available by the manufacturer of the packaged boiler.

PART 3 EXECUTION

3.1 INSTALLATION

Arrange work in a neat and orderly manner so that minimum storage of equipment and material is required at the project site. Install equipment and material in accordance with the best commercial practices. Systems shall be neat in appearance, compact, adequate in construction and assembly, and installed for long and continuous service. Parts shall be readily accessible for inspection, repair, and renewal. Inspect equipment and material upon delivery and test after installation. Protect material and equipment from the weather. Repair damage caused by the Contractor in execution of the work and leave in a condition equal to that existing before work was started.

3.1.1 Equipment Base

Locate as shown and construct of sufficient size and weight and of proper design to preclude shifting of equipment under operating conditions or under abnormal conditions that could be imposed upon the equipment. Base frame and anchorage shall meet requirements of equipment manufacturer. Install piping in such a manner so as not to place a strain on equipment.

3.1.2 Welding

Work shall be in accordance with the applicable sections of the

ASME BPVC SEC IV, Section 40 17 26.00 20, WELDING PRESSURE PIPING and AWS Z49.1.

3.1.3 Painting

Equipment shall be factory finished to withstand the intended end use environment in accordance with the specifications for the particular end item. Field paint equipment not factory finished as specified herein. Retouch damaged areas of factory-finished equipment on which the finish has been damaged and then give a complete finish coat to restore the finish to its original condition. The finish coat shall be suitable for exposure in the intended end use environment. Spray painting shall comply with OSHA 29 CFR 1910.

3.1.3.1 Cleaning and Application

Remove dirt, rust, oil, and grease by wire brushing and solvent degreasing prior to application of paint. Apply paint to clean and dry surfaces only. Where more than one coat of paint is specified, apply the second coat after the first coat is thoroughly dry. Retouch damaged painting before applying the succeeding coat. Finished surfaces shall be smooth. The painting of zinc coated and other corrosion-resistant metal surfaces is not required unless otherwise specified herein.

3.1.4 Boiler Cleaning

After installation, the boiler shall be boiled out, under supervision of the manufacturer, with soda ash or equivalent solution to clean internal surfaces of oil, grease, mill scale, and dirt. Following treatment, the boiler shall be flushed, drained and then opened and washed down and inspected to ensure that no traces of oil or foreign matter are present. The boiler and associated piping shall then be drained and refilled with treated softened water. At all times after initial cleaning, the Contractor shall protect the boiler, tanks, and piping against internal corrosion until testing is completed and the boiler is accepted. Provide chemicals, labor for introducing chemicals, and professional services for control and supervision of the treatment process.

3.2 FIELD QUALITY CONTROL

Perform inspections and tests as specified herein to demonstrate that the boiler and auxiliary equipment, as installed, are in compliance with contract requirements. During boiler system start-up tests, factory-trained engineers or technicians employed by individual suppliers of such components as the burner, flame safeguard and combustion controls shall be present, as required, to ensure the proper functioning, adjustment, and testing of individual components and systems. No bypassing, use of jumpers, or other disablement of control systems will be allowed unless specified elsewhere. Labor, equipment, and test apparatus required for testing shall be furnished by the Contractor. Rectify defects disclosed by the tests by the Contractor within time period specified by the Contracting Officer.

3.2.1 Inspections and Test

Make inspections and tests at the site under the direction of and subject to the approval of the Contracting Officer. The Contractor shall operate the boiler and appurtenances prior to final testing and shall ensure that necessary adjustments have been made. A 48- hour written notice shall be

submitted to the Contracting Officer indicating the equipment is ready for inspection or testing. Provide testing equipment, including gages, thermometers, calorimeter, Orsat apparatus, thermocouple pyrometers, fuel flow meters, water meters, and other test apparatus and set up and calibrate prior to the test. Draft, fuel pressure, and steam flow may be measured by permanent gages and meters installed under the contract. Provide an analysis of the fuel being used for tests. Control of noise levels developed by exhaust steam including muffler, globe, and gate valves shall be conducted in such a manner as not to create a nuisance or hazard and shall be subject to the approval of the Contracting Officer. Tests shall include the following, and shall be performed when feasible, in the sequence listed:

a. Strength and tightness tests

b. Standards compliance tests

c. Combustion tests

d. Operational tests

e. Capacity and efficiency tests

f. Tests of auxiliary equipment

g. Feedwater equipment test

3.2.2 Strength and Tightness Tests

Subject boiler to the following strength and tightness tests:

3.2.2.1 Hydrostatic Test

After installation and connection, subject the boiler to an inspection and hydrostatic test to determine that the boiler and appurtenances have not been damaged in transit or handling. The hydrostatic test shall be in accordance with the ASME Code with the test pressure applied for a period required by the Contracting Officer. This test shall be in addition to the hydrostatic tests performed at the factory.

3.2.2.2 Internal Component Pressure Tests

The part of the pre-assembled gas system that is furnished integrally with the boiler shall be pneumatically tested at operating pressure. Use the soap bubble test method to verify tightness of the gas system.

3.2.3 Combustion Tests

Test the fuel burning and combustion control equipment with the specified fuel at the minimum limit of the turndown range and at increments of 50, 75, and 100 percent of full rated load . Tests shall be conducted by factory-trained combustion equipment engineers as previously specified. The combustion control system shall demonstrate that equipment installed will meet the requirements of the specification, and that an overall efficiency as specified, with not over 15 percent excess air, can be obtained with boiler operating at 100 percent capacity. Analyze test data and graphically present to show for the boiler at tested loads: rates of steam flow; flue gas temperature; percent excess air; steam quality; and percentages of carbon dioxide, carbon monoxide, and oxygen in the flue

gas. Monitor concentrations of sulfur oxides, particulate, and nitrogen oxides in the flue gas to ensure compliance with environmental requirements. Run tests on each fuel until stack temperatures are constant and conformance with the combustion requirements of this specification has been verified and recorded. Verify proper operation of instrumentation and gauges in the control panel during the test.

3.2.4 Operational Test

Continuously test the boiler(s) under varying load conditions to demonstrate proper operability of the combustion control, flame safeguard control, programming control, and safety interlocks. Conduct this test after the adjustment of the combustion controls has been completed under the combustion test. The operational test shall continue for a period of at least 8 hours and shall include the following:

3.2.4.1 Sequencing

The boiler shall start, operate, and stop in strict accordance with the specified operating sequence.

3.2.4.2 Flame Safeguard

Verify the operation of the flame safeguard controls by simulated flame and ignition failures. Test burners having intermittent pilots by simulating main flame failure while the pilot is burning. Verify by stop watch the trial-for-pilot ignition, trial-for-main flame ignition, combustion control reaction, and valve closing times.

3.2.4.3 Immunity to Hot Refractory

Operate the burner at high fire until the combustion chamber refractory reaches maximum temperature. Then manually close the main fuel valve. The combustion safeguard shall drop out immediately causing the safety shutoff valves to close within the specified control reaction and valve closing times.

3.2.4.4 Pilot Intensity Required

Gradually reduce the fuel supply to the pilot flame to the point at which the combustion safeguard begins to drop out (sense "no flame") but holds in until the main fuel valve opens. At this point of reduced pilot fuel supply, the pilot flame shall be capable of safely igniting the main burner. If the main fuel valve can be opened on a pilot flame of insufficient intensity to safely light the main flame, readjustment of fire eye is required.

3.2.4.5 Immunity to Ignition Spark

Where ultra violet flame detectors are employed, the pilot and main burner manual safety shut off valves shall be closed. The burner shall then be operated through the trial for pilot ignition period. The flame safeguard relay shall not respond to the presence of electric spark. If the flame safeguard relay responds to the presence of electric spark, reject the boiler.

3.2.4.6 Boiler Limit and Fuel Safety Interlocks

Safety shutdowns shall be caused by simulating interlock actuating

conditions for each boiler limit and fuel safety interlock. Safety shutdowns shall occur in the specified manner.

3.2.4.7 Combustion Controls

Demonstrate the accuracy, range, and smoothness of operation of the combustion controls by varying the steam demand through the entire firing range required by the turndown ratio specified for the burner and in case of automatic recycling burners, by further varying the firing rate to require "on-off" cycling. Control accuracy shall be as specified

3.2.4.8 Safety Valves

The high-pressure limit switch shall be locked out or otherwise made inoperative, and the boiler safety valves shall be lifted by steam. Determine the relieving capacity, popping pressure, blowdown, and reseating pressure by observation and measurement to be in accordance with the ASME Boiler and Pressure Vessel Code. The ASME standard symbol will be accepted only as indicating compliance with the design and material requirements of the code.

3.2.5 Capacity and Efficiency Tests

Perform the capacity and efficiency tests after satisfactory completion of all tests previously specified herein and after the boilers have been operating continuously for one day with no nuisance shutdowns and without the necessity for frequent or difficult adjustments. Conduct tests using the specified fuels. Test procedures shall be in accordance with the heat loss method of the ASME PTC 4 and shall be reported on the ASME Test Form for Abbreviated Efficiency Test. The duration of the tests shall be sufficient to record necessary data but in no case shall test duration be less than 4 hours.

3.2.6 Auxiliary Equipment and Accessory Tests

Observe and check blowdown valves, stop valves, try cocks, draft fans, pumps, electric motors, and other accessories and appurtenant equipment during the operational and capacity tests for leakage, malfunctions, defects, noncompliance with referenced standards, or overloading, as applicable.

3.2.7 Feedwater Equipment Tests

Perform the test of the feedwater treatment equipment in two steps. Conduct one test by the Contractor concurrently with either the combustion test or the capacity and efficiency test. A second test will be performed by the Government during the first period of heavy loading after the plant has been accepted and put in service. Deficiencies revealed during the Government tests will be corrected under the guarantee provisions of the contract. Both the first and second series of tests shall determine compliance with the limits for oxygen content and hardness concentrations of this specification. Equipment for taking samples and the test kit for analyzing the samples shall be supplied by the Contractor and shall revert to the Government when the tests are completed.

3.2.8 Preliminary Operational Test

Operate each boiler and appurtenances prior to final testing and insure that necessary adjustments have been made. Provide testing equipment

required to perform tests. During this testing period, provide operating instructions and training to persons tasked with operation of the boiler.

Conduct a preliminary operational test prior to requesting an acceptance operational test and inspection by the Contracting Officer. Ten days advance notice is required for scheduling the inspector to conduct acceptance operational test and inspection.

3.3 FIELD TRAINING

Conduct a training course for the operating staff as designated by the COR. The training period shall consist of a total of 4 hours of normal working time and shall start after the system is functionally completed, but prior to final acceptance tests.

a. The field instructions shall cover all of the items contained in the approved operation and maintenance manuals, as well as demonstrations of routine maintenance operations and boiler safety devices.

b. Submit system layout diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system, framed under glass or laminated plastic, at least 2 weeks prior to the start of related testing. After approval, these items shall be posted where directed.

c. Submit six complete operation and maintenance instructions listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, simplified wiring and control diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization shall be capable of providing 4 hour on-site response to a service call on an emergency basis.

d. Notify the COR at least 14 days prior to date of proposed conduction on the training course.

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SECTION 23 81 48

PLATE HEAT EXCHANGER

PART 1 GENERAL

1.1 SUMMARY

'This section covers the plate heat exchangers.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM B117	Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM F 402	Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 704	Standard System for the Identification of the Hazards of Materials for Emergency Response

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

As-Built Drawings

SD-03 Product Data

Plate heat exchangers

SD-06 Test Reports

Plate Heat Exchangers - field acceptance test plan

Plate Heat Exchangers - field acceptance test report

SD-08 Manufacturer's Instructions

Plate Heat Exchangers - installation instructions

ON-SITE TRAINING

SD-10 Operation and Maintenance Data

Plate Heat Exchangers, Data Package 2

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.4.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.4.3 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.4.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.4.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the COR.

1.4.5.1 Definitions

For the Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "COR." For Navy owned property, references to the "owner" shall be interpreted to mean the "COR." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.4.5.2 Administrative Interpretations

For Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the Codes to sections of Chapter 1, shall be applied appropriately by the COR as authorized by his administrative cognizance and the FAR.

1.5 DELIVERY, STORAGE, AND HANDLING

Materials delivered and placed in storage shall be stored with protection from the weather, excessive humidity variation, excessive temperature variation, dirt, dust and/or other contaminants. Proper protection and care of material before, during and after installation is the Contractor's responsibility. Any material found to be damaged shall be replaced at the Contractor's expense. During installation, piping shall be capped to keep out dirt and other foreign matter. Handling shall be in accordance with ASTM F 402. Storage facilities shall be classified and marked in accordance with NFPA 704. Materials shall be stored with protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, ultraviolet (UV) radiation damage, or other damage. Upon delivery of equipment to the site, inspect items for damage and verify items meet project requirements.

1.6 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions indicated in the field, and advise the COR of any discrepancy before performing any work.

1.7.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets,

fittings, and accessories to meet such conditions.

1.7.3 Accessibility

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible.

PART 2 PRODUCTS

2.1 EQUIPMENT

2.1.1 Plate Heat Exchangers

Plates, frames, and gaskets shall be designed and stamped per ASME Section 8, D-1 for a working pressure of 75 psi and factory tested at 98 psi. Heat exchanger shall be registered with The National Board. Connections larger than 3 inches shall be ASME 150 pound flanged. Plates shall be corrugated Type 316 stainless steel.

2.2 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein. New equipment surfaces constructed of non-ferrous surfaces and materials do not have to be factory or shop painted.

2.2.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied shall withstand 3000 hours in a salt-spray fog test. Field applied coatings are not acceptable. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

PART 3 EXECUTION

3.1 FIELD PAINTING AND FINISHING

Requirements for field painting and finishing are specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 INSTRUCTING OPERATING PERSONNEL

Upon completion of work and at time designated by COR, provide services of manufacturer's technical representative for period of not less than one 4 -hour working day for instruction of Government operating personnel in proper operation and maintenance of equipment.

3.3 FIELD QUALITY CONTROL

Upon completion and before final acceptance of work, test each system in service to demonstrate compliance with the contract requirements. Adjust controls and balance systems prior to final acceptance of completed systems. Test controls through every cycle of operation. Test safety controls to demonstrate performance of required function. Correct defects in work provided by Contractor and repeat tests. Furnish fuel, water, electricity, instruments, connecting devices, and personnel for tests. Flush and clean piping before placing in operation. Clean equipment, piping, strainers, ducts, and filters.

3.3.1 Equipment Tests

3.3.1.1 Field Testing

Test each item of equipment in operation, for continuous period of not more than 24 hours under every condition of operation in accordance with each equipment manufacturer's recommendation. Verify that each item of equipment operating parameters are within limits recommended by the manufacturer.

3.3.1.2 Field Test Plans

Furnish field test plans developed by each equipment manufacturer detailing recommended field test procedures for each item of equipment. Field test plans developed by the installing Contractor, or the equipment sales agency furnishing the equipment will not be acceptable. The COR will review and approve the field test plan for each item of equipment listed below prior to commencement of field testing of the equipment.

a. Equipment Items to Test:

   Plate Heat Exchangers - field acceptance test plan

b. Coordinated Testing: Indicate in each field test plan when work required by this section requires coordination with test work required by other specification sections. Furnish test procedures for the simultaneous or integrated testing of equipment controls

c. Prerequisite Testing: Equipment for which performance testing is dependent upon the completion of the work covered by 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC shall have that work completed as a prerequisite to testing work under this section. Indicate in each field test plan when such prerequisite work is required.

d. Test Procedure: Indicate in each field test plan each equipment manufacturer's published installation, start-up, and field acceptance test procedures. Each test plan shall include the required test reporting forms to be completed by the Contractor's testing representatives.

e. Performance Variables: Each test plan shall list performance variables that are required to be measured or tested as part of the field test. Include in the listed variables performance requirements indicated on the equipment schedules on the design drawings. Furnish with each test procedure a description of acceptable results that have been verified. Identify the acceptable limits or tolerances within which each tested performance variable shall acceptably operate.

f. Job Specific: Each test plan shall be job specific and shall address the particular item of equipment and particular conditions which exist with this contract. Generic or general preprinted test procedures are not acceptable.

3.3.1.3 Field Test Reports

a. Equipment Items to Test

Plate Heat Exchangers - field acceptance test report

b. Manufacturer's Recommended Test: Conduct the manufacturer's recommended field testing in compliance with the approved test plan specified above.

c. Operational Test: Conduct a standard continuous 24 hour operational test for each item of equipment. Equipment shutdown before the test period is completed shall result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every 2 hours. Use the test report forms for logging the operational variables.

d. Notice of Tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the approved reporting forms. Notify the COR in writing at least 15 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for review and approval.

e. Report Forms: Type data entries and writing on the test report forms. Completed test report forms for each item of equipment shall be reviewed, approved, and signed by the Contractor's test director and the QC Manager. The manufacturer's field test representative shall review, approve, and sign the report of the manufacturer's recommended test. Signatures shall be accompanied by the person's name typed.

f. Deficiency Resolution: The test requirements acceptably met; deficiencies identified during the tests shall be corrected in compliance with the manufacturer's recommendations and corrections retested to verify compliance.

3.3.2 Additional Field Testing

Requirements for testing, adjusting, and balancing (TAB) of equipment is specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Testing, adjusting, and balancing shall begin only when the entire system, including controls, has been completed with the exception of performance tests.

3.3.3 ON-SITE TRAINING

The heat exchanger specialist shall conduct a training course for operating and maintenance personnel as designated by the COR. Training shall be provided for a period of 4 hours of normal working time and shall start after the system is functionally complete but prior to the performance tests. The on-site training shall cover all of the items contained in the approved Operation and Maintenance Data packages.

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ROOFTOP AIR CONDITIONING UNIT

PART 1 GENERAL

1.1 SUMMARY

This section covers unitary (packaged and split systems) air-conditioners, heat pumps, and accessories.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 410	Forced-Circulation Air-Cooling and Air-Heating Coils
AHRI 700	Specifications for Fluorocarbon Refrigerants
ANSI/AHRI 270	Sound Rating of Outdoor Unitary Equipment
ANSI/AHRI 340/360	Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
ANSI/AHRI 495	Performance Rating of Refrigerant Liquid Receivers

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ANSI/ASHRAE 15 & 34	ANSI/ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants
ASHRAE 52.2	Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

AMERICAN WELDING SOCIETY (AWS)

AWS Z49.1	Safety in Welding and Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

ASME BPVC SEC VIII D1	BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM B117	Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM C 1071	Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM D 520	Zinc Dust Pigment
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F 104	Standard Classification System for Nonmetallic Gasket Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	Motors and Generators
NEMA MG 2	Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators

UNDERWRITERS LABORATORIES (UL)

UL 1995	Heating and Cooling Equipment
UL 900	Standard for Air Filter Units

1.3 SYSTEM DESCRIPTION

Provide electrical equipment, motors, motor efficiencies, and wiring which are in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics shall be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, or totally enclosed, fan cooled enclosures, shall be the premium efficiency type in accordance with NEMA MG 1. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors shall be furnished with a magnetic across-the-line as required by the manufacturer. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval

between start and stop. Motors shall be sized for the applicable loads. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings

SD-03 Product Data

Materials and Equipment
Spare Parts
Posted Instructions
Verification of Dimensions
Coil Corrosion Protection
System Performance Tests
Demonstrations

SD-06 Test Reports

Refrigerant Tests, Charging, and Start-Up
System Performance Tests

SD-07 Certificates

Materials and Equipment
Service Organization

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

1.5 QUALITY ASSURANCE

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Submit drawings provided in adequate detail to demonstrate compliance with contract requirements. Carefully investigate the plumbing, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. Submit drawings consisting of:

a. Equipment layouts which identify assembly and installation details.

b. Plans and elevations which identify clearances required for maintenance and operation.

c. Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.

d. Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.

e. Automatic temperature control diagrams and control sequences.

f. Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.

1.6 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Replace any materials found to be damaged at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.7 EXTRA MATERIALS

Submit spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

Submit manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements.

a. Data shall include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Data shall be submitted for each specified component.

b. Where the system, components, or equipment are specified to comply with requirements of AHRI, ASHRAE, ASME, or UL, proof of such compliance shall be provided. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted.

c. When performance requirements of this project's drawings and specifications vary from standard AHRI rating conditions, computer printouts, catalog, or other application data certified by AHRI or a nationally recognized laboratory as described above shall be included.

If AHRI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

2.1.2 Nameplates

Major equipment including compressors, condensers, receivers, heat exchanger s, fans, and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate secured to the item of equipment. Plates shall be durable and legible throughout equipment life and made of stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.1.3 Safety Devices

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

2.2 UNITARY EQUIPMENT, PACKAGE SYSTEM

Unit shall be an air-cooled factory assembled, weatherproof packaged unit as indicated. Unit shall be the air-conditioning type conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit shall be rated in accordance with ANSI/AHRI 340/360. Unit shall be provided with equipment as specified in paragraph "Unitary Equipment Components". Evaporator or supply fans shall be double-width, double inlet, forward curved, backward inclined, or airfoil blade, centrifugal scroll type. Motors shall have totally enclosed enclosures. Condenser fans shall be manufacturer's standard for the unit specified and may be either propeller or centrifugal scroll type. Unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged with refrigerant and oil in accordance with manufacturer's recommendations. Outdoor unit shall produce a maximum AHRI sound rating of 8.4 bells in accordance with ANSI/AHRI 270.

2.2.1 Air-to-Refrigerant Coils

Air-to-refrigerant coils shall have copper tubes of 3/8 inch minimum diameter with copper fins that are mechanically bonded or soldered to the tubes. Coil shall be protected in accordance with paragraph COIL CORROSION PROTECTION. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ANSI/ASHRAE 15 & 34 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Separate expansion devices shall be provided for each compressor circuit.

2.2.2 Compressor

Compressor shall be direct drive, semi-hermetic or hermetic reciprocating, or scroll type capable of operating at partial load conditions. Compressor shall be capable of continuous operation down to the lowest step of unloading as specified. If standard with the manufacturer, two or more

compressors may be used in lieu of a single compressor with unloading capabilities, in which case the compressors shall operate in sequence, and each compressor shall have an independent refrigeration circuit through the condenser and evaporator. Compressors shall start in the unloaded position. Each compressor shall be provided with vibration isolators, crankcase heater, thermal overloads, high and low pressure safety cutoffs and protection against short cycling.

2.2.3 Refrigeration Circuit

Refrigerant containing components shall comply with ANSI/ASHRAE 15 & 34 and be factory tested, cleaned, dehydrated, charged, and sealed. Refrigerant charging valves and connections, and pumpdown valves shall be provided for each circuit. Filter-drier shall be provided in each liquid line and be reversible-flow type. Refrigerant flow control devices shall be an adjustable superheat thermostatic expansion valve with external equalizer matched to coil, capillary or thermostatic control.

2.2.4 Unit Controls

Unit shall be internally prewired with a 24 volt control circuit powered by an internal transformer. Terminal blocks shall be provided for power wiring and external control wiring. Unit shall have cutoffs for high and low pressure, supply fan failure and safety interlocks on all service panels. Head pressure controls shall sustain unit operation with ambient temperature of 105. Adjustable-cycle timers shall prevent short-cycling. Multiple compressors shall be staged by means of a time delay. Unit shall be internally protected by fuses or a circuit breaker in accordance with UL 1995. Low cost cooling shall be made possible by means of a control circuit which will modulate dampers to provide 100 percent outside air while locking out compressors.

2.3 EQUIPMENT EFFICIENCY

Unit shall have an efficiency as indicated on the drawings.

2.4 UNITARY EQUIPMENT COMPONENTS

2.4.1 Refrigerant and Oil

Refrigerant shall be one of the fluorocarbon gases. Refrigerants shall have number designations and safety classifications in accordance with ANSI/ASHRAE 15 & 34. Refrigerants shall meet the requirements of AHRI 700 as a minimum. Refrigerants shall have an Ozone Depletion Potential (ODP) of less than or equal to 0.05. Provide and install a complete charge of refrigerant for the installed system as recommended by the manufacturer. Lubricating oil shall be of a type and grade recommended by the manufacturer for each compressor. Where color leak indicator dye is incorporated, charge shall be in accordance with manufacturer's recommendation.

2.4.2 Fans

Fan wheel shafts shall be supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Unit fans shall be selected to produce the cfm required at the fan total pressure. Motor starters, if applicable, shall be magnetic across-the-line type with a totally enclosed enclosure. Thermal overload protection shall be of the manual or automatic-reset type. Fan wheels or

propellers shall be constructed of aluminum or galvanized steel. Centrifugal fan wheel housings shall be of galvanized steel, and both centrifugal and propeller fan casings shall be constructed of aluminum or galvanized steel. Steel elements of fans, except fan shafts, shall be hot-dipped galvanized after fabrication or fabricated of mill galvanized steel. Mill-galvanized steel surfaces and edges damaged or cut during fabrication by forming, punching, drilling, welding, or cutting shall be recoated with an approved zinc-rich compound. Fan wheels or propellers shall be statically and dynamically balanced. Direct-drive fan motors shall be with speed controller for balancing. Belt-driven fans shall have adjustable sheaves to provide not less than 20 percent fan-speed adjustment. The sheave size shall be selected so that the fan speed at the approximate midpoint of the sheave adjustment will produce the specified air quantity. Centrifugal scroll-type fans shall be provided with streamlined orifice inlet and V-belt drive. Each drive will be independent of any other drive. Propeller fans shall be direct-drive drive type with fixed pitch blades. V-belt driven fans shall be mounted on a corrosion protected drive shaft Each drive will be independent of any other drive. Drive bearings shall be protected with water slingers or shields. V-belt drives shall be fitted with guards where exposed to contact by personnel and fixed pitch sheaves.

2.4.3 Heating

2.4.3.1 Water Coil

Coil shall conform to the provisions of AHRI 410. Coil shall be fin-and-tube type constructed of seamless copper tubes and copper fins mechanically bonded or soldered to tubes. Headers shall be constructed of cast iron, welded steel or copper. Coil shall be constructed to float within the casing to allow free expansion and contraction of tubing. Casing and tube support sheets shall not be lighter than 16 gauge galvanized steel formed to provide structural strength. When required, multiple tube supports shall be provided to prevent tube sag. Coil shall be circuited for suitable water velocity without excessive pressure drop and properly pitched for drainage where required or indicated. Each coil shall be tested at the factory under water at not less than 300 psi air pressure, tested hydrostatically after assembly of the unit and proved tight under a gauge pressure of 200 psi. Coil shall be suitable for use with water up to 250 degrees F. Coil shall allow complete coil drainage with a pitch of not less than 1/8 inch/foot slope to drain.

2.4.4 Air Filters

Air filters shall be listed in accordance with requirements of UL 900,

2.4.4.1 Extended Surface Pleated Panel Filters

Provide 2 inch depth, sectional, disposable type filters of the size indicated with a MERV of 8 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.36 inches water gauge. Provide UL Class 2 filters, and nonwoven cotton and synthetic fiber mat media. Attach a wire support grid bonded to the media to a moisture resistant fiberboard frame. Bond all four edges of the filter media to the inside of the frame to prevent air bypass and increase rigidity.

2.4.4.2 Cartridge Type Filters

Provide 12 inch depth, sectional, replaceable dry media type filters of the

size indicated with a MERV of 13 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.56 inches, water gauge. Provide UL class 1 filters, and pleated microglass paper media with corrugated aluminum separators, sealed inside the filter cell to form a totally rigid filter assembly. Fluctuations in filter face velocity or turbulent airflow have no effect on filter integrity or performance. Install each filter with an extended surface pleated media panel filter as a prefilter in a factory preassembled side access housing.

2.4.4.3 Filter Gauges

Provide dial type filter gauges, diaphragm actuated draft for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Gauges shall be at least 3-7/8 inches in diameter, with white dials with black figures, and graduated in 0.01 inch of water, with a minimum range of 1 inch of water beyond the specified final resistance for the filter bank on which each gauge is applied. Provide each gauge with a screw operated zero adjustment and two static pressure tips with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter aluminum tubing, and all hardware and accessories for gauge mounting.

2.4.5 Coil Frost Protection

Each circuit shall be provided with a coil frost protection system which is a manufacturer's standard. The coil frost protection system shall use a temperature sensor in the suction line of the compressor to shut the compressor off when coil frosting occurs. Timers shall be used to prevent the compressor from rapid cycling.

2.4.6 Pressure Vessels

2.4.6.1 Hot Gas Muffler

Unit shall be selected by the manufacturer for maximum noise attenuation. Units rated for 30 tons capacity and under may be field tunable type.

2.4.6.2 Liquid Receiver

A liquid receiver shall be provided when a system's condenser or compressor does not contain a refrigerant storage capacity of at least 20 percent in excess of a fully charged system. Receiver shall be designed, filled, and rated in accordance with the recommendations of ANSI/AHRI 495, except as modified herein. Receiver shall be fitted to include an inlet connection; an outlet drop pipe with oil seal and oil drain where necessary; two bull's-eye liquid level sight glass in same vertical plane, 90 degrees apart and perpendicular to axis of receiver or external gauge glass with metal guard and automatic stop valves; thermal well for thermostat; float switch column; external float switches; and purge, charge, equalizing, pressurizing, plugged drain and service valves on the inlet and outlet connections. Receiver shall be provided with a relief valve of capacity and setting in accordance with ANSI/ASHRAE 15 & 34.

2.4.6.3 Oil Separator

Separator shall be the high efficiency type and be provided with removable flanged head for ease in removing float assembly and removable screen cartridge assembly. Pressure drop through a separator shall not exceed 10 psi during the removal of hot gas entrained oil. Connections to compressor

shall be as recommended by the compressor manufacturer. Separator shall be provided with an oil float valve assembly or needle valve and orifice assembly, drain line shutoff valve, sight glass, filter for removal of all particulate sized 10 microns and larger, thermometer and low temperature thermostat fitted to thermal well, immersion heater, external float valve fitted with three-valve bypass, and strainer.

2.4.6.4 Oil Reservoir

Reservoir capacity shall equal one charge of all connected compressors. Reservoir shall be provided with an external liquid gauge glass, plugged drain, and isolation valves. Vent piping between the reservoir and the suction header shall be provided with a 5 psi pressure differential relief valve. Reservoir shall be provided with the manufacturer's standard filter on the oil return line to the oil level regulators.

2.4.7 Internal Dampers

Dampers shall be parallel blade type with renewable blade seals and be integral to the unitary unit. Damper provisions shall be provided for each outside air intake, exhaust, economizer, and mixing boxes. Dampers shall have automatic modulation and operate as specified.

2.4.8 Cabinet Construction

Casings for the specified unitary equipment shall be constructed of galvanized steel or aluminum sheet metal and galvanized or aluminum structural members. Minimum thickness of single wall exterior surfaces shall be 18 gauge galvanized steel or 0.071 inch thick aluminum on units with a capacity above 20 tons and 20 gauge galvanized steel or 0.064 inch thick aluminum on units with a capacity less than 20 tons. Casing shall be fitted with lifting provisions, access panels or doors, fan vibration isolators, electrical control panel, corrosion-resistant components, structural support members, insulated condensate drip pan and drain, and internal insulation in the cold section of the casing. Where double-wall insulated construction is proposed, minimum exterior galvanized sheet metal thickness shall be 20 gauge. Provisions to permit replacement of major unit components shall be incorporated. Penetrations of cabinet surfaces, including the floor, shall be sealed. Unit shall be fitted with a drain pan which extends under all areas where water may accumulate. Drain pan shall be fabricated from Type 300 stainless steel, galvanized steel with protective coating as required, or an approved plastic material. Pan insulation shall be water impervious. Extent and effectiveness of the insulation of unit air containment surfaces shall prevent, within limits of the specified insulation, heat transfer between the unit exterior and ambient air, heat transfer between the two conditioned air streams, and condensation on surfaces. Insulation shall conform to ASTM C 1071. Paint and finishes shall comply with the requirements specified in paragraph FACTORY COATING.

2.4.8.1 Outdoor Cabinet

Outdoor cabinets shall be suitable for outdoor service with a weathertight, insulated and corrosion-protected structure. Cabinets constructed exclusively for indoor service which have been modified for outdoor service are not acceptable.

2.5 ACCESSORIES

2.5.1 Refrigerant Relief Valve/Rupture Disc Assembly

The assembly shall be a combination pressure relief valve and rupture disc designed for refrigerant usage. The assembly shall be in accordance with ASME BPVC SEC VIII D1 and ANSI/ASHRAE 15 & 34. The assembly shall be provided with a pressure gauge assembly which will provide local indication if a rupture disc is broken. Rupture disc shall be the non-fragmenting type.

2.5.2 Refrigerant Signs

Refrigerant signs shall be a medium-weight aluminum type with a baked enamel finish. Signs shall be suitable for indoor or outdoor service. Signs shall have a white background with red letters not less than 0.5 inches in height.

2.5.2.1 Installation Identification

Each new refrigeration system shall be provided with a refrigerant sign which indicates the following as a minimum:

a. Contractor's name.

b. Refrigerant number and amount of refrigerant.

c. The lubricant identity and amount.

d. Field test pressure applied.

2.5.3 Gaskets

Gaskets shall conform to ASTM F 104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

2.5.4 Bolts and Nuts

Bolts and nuts shall be in accordance with ASTM A307. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A307.

2.5.5 Bird Screen

Screen shall be 0.063 inch diameter aluminum wire or 0.031 inch diameter stainless steel wire.

2.5.6 Outside Air Intakes

Provide the manufacturer's standard design outside air intakes furnished with 1/2 inch mesh bird screen or louvers on 1/2 inch centers.

2.6 FINISHES

2.6.1 Factory Coating

2.6.1.1 Coil Corrosion Protection

Provide coil with a uniformly applied epoxy electrodeposition, phenolic, or

vinyl type coating to all coil surface areas without material bridging between fins. Submit product data on the type coating selected, the coating thickness, the application process used, the estimated heat transfer loss of the coil, and verification of conformance with the salt spray test requirement. Coating shall be applied at either the coil or coating manufacturer's factory. Coating process shall ensure complete coil encapsulation. Coating shall be capable of withstanding a minimum 1,000 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution.

2.6.1.2 Equipment and Components

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

2.6.2 Factory Applied Insulation

Refrigeration equipment shall be provided with factory installed insulation on surfaces subject to sweating including the suction line piping. Where motors are the gas-cooled type, factory installed insulation shall be provided on the cold-gas inlet connection to the motor in accordance with manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

2.7 SUPPLEMENTAL COMPONENTS/SERVICES

2.7.1 Ductwork

Ductwork shall be provided and installed in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.7.2 Temperature Controls

Temperature controls shall be in accordance with Section ?? ?? ??HVAC control requirements on drawings. Fully coordinated with and integrated into the existing FMCS system.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, perform Verification of Dimensions in the field, and advise the COR of any discrepancy before performing any work. Submit a letter, at least 2 weeks prior to beginning construction, including the date the site was visited, confirmation of existing conditions, and any discrepancies found.

3.2 INSTALLATION

Work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements.

3.2.1 Equipment

Refrigeration equipment and the installation thereof shall conform to ANSI/ASHRAE 15 & 34. Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, condensers, and similar items. Compressors shall be isolated from the building structure. If mechanical vibration isolators are not provided, vibration absorbing curbs shall be provided with seismic restraint. Each curb shall include isolation units consisting of machine and curb fastenings, together with intermediate isolation material. Isolators shall be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Isolators shall limit vibration to 2 percent at lowest equipment rpm. Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.2.2 Field Applied Insulation

Field applied insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.2.3 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09 90 00 PAINTS AND COATINGS.

3.3 CLEANING AND ADJUSTING

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions. Testing, adjusting, and balancing shall be as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.4 DEMONSTRATIONS

Conduct a training course for the operating staff as designated by the COR. The training period shall consist of a total 8 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests.

a. Submit a schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

b. Submit the field posted instructions, at least 2 weeks prior to construction completion, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions shall be framed under glass or laminated plastic and be posted where indicated by the COR.

c. The posted instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations. Submit 6 complete copies of an operation manual in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

d. Submit 6 complete copies of maintenance manual in bound 8-1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

3.5 REFRIGERANT TESTS, CHARGING, AND START-UP

Packaged refrigerant systems which are factory charged shall be checked for refrigerant and oil capacity to verify proper refrigerant levels in accordance with manufacturer's recommendations. Following charging, packaged systems shall be tested for leaks with a halide torch or an electronic leak detector. Submit 6 copies of each test containing the information described below in bound 8-1/2 by 11 inch booklets. Individual reports shall be submitted for the refrigerant system tests.

a. The date the tests were performed.

b. A list of equipment used, with calibration certifications.

c. Initial test summaries.

d. Repairs/adjustments performed.

3.5.1 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

3.5.2 Contractor's Responsibility

Take steps, at all times during the installation and testing of the refrigeration system, to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

3.6 SYSTEM PERFORMANCE TESTS

Before each refrigeration system is accepted, conduct tests to demonstrate the general operating characteristics of all equipment by a professional engineer registered in the State of California or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as directed. Six copies of the report provided in bound 8-1/2 by 11 inch booklets. The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system.

a. Submit a schedule, at least 2 weeks prior to the start of related testing, for the system performance tests. The schedules shall identify the proposed date, time, and location for each test. Tests shall cover a period of not less than 48 hours for each system and shall demonstrate that the entire system is functioning in accordance with the drawings and specifications.

b. Make corrections and adjustments, as necessary, tests shall be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, service valve seal caps and blanks over gauge points shall be installed and tightened. Any refrigerant lost during the system startup shall be replaced.

c. If tests do not demonstrate satisfactory system performance, deficiencies shall be corrected and the system shall be retested. Tests shall be conducted in the presence of the COR. Water and electricity required for the tests will be furnished by the Government. Provide all material, equipment, instruments, and personnel required for the test.

d. Field tests shall be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Submit 6 copies of the report provided in bound 8-1/2 by 11 inch booklets. The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the

number of days covered by the tests and any conclusions as to the adequacy of the system. Submit the report including the following information (where values are taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart):

a. Date and outside weather conditions.

b. The load on the system based on the following:

   1. The refrigerant used in the system.

   2. Condensing temperature and pressure.

   3. Suction temperature and pressure.

   4. Ambient, condensing and coolant temperatures.

   5. Running current, voltage and proper phase sequence for each phase of all motors.

c. The actual on-site setting of operating and safety controls.

d. Thermostatic expansion valve superheat - value as determined by field test.

e. Subcooling.

f. High and low refrigerant temperature switch set-points

g. Low oil pressure switch set-point.

h. Defrost system timer and thermostat set-points.

i. Moisture content.

j. Capacity control set-points.

k. Field data and adjustments which affect unit performance and energy consumption.

l. Field adjustments and settings which were not permanently marked as an integral part of a device.

-- End of Section --

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SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

This section covers electrical general requirements, complete.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM D 709	Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	National Electrical Safety Code
IEEE C57.12.28	Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

1.3 RELATED REQUIREMENTS

This section applies to certain sections of Division 02, EXISTING CONDITIONS and Divisions 22 and 23, PLUMBING and HEATING VENTILATING AND AIR CONDITIONING. This section applies to all sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections. This section has been incorporated

into, and thus, does not apply to, and is not referenced in the following sections.

Section 26 12 19.00 40 PAD MOUNTED LIQUID FILLED MEDIUM VOLTAGE TRANSFORMERS
Section 26 51 00.00 40 INTERIOR LIGHTING
Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM

1.4 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.5 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 13.8 kV primary, three phase, three wire, 6 Hz, and 480/277 volts secondary, three phase, four wire. Final connections to the power distribution system at the existing substation shall be made by the Contractor as directed by the COR.

1.6 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

SD-03 Product Data

Submittal shall include performance and characteristic curves.

1.7 QUALITY ASSURANCE

1.7.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the COR. Equipment, materials, installation, and

workmanship shall be in accordance with the mandatory and advisory provisions of CEC unless more stringent requirements are specified or indicated.

1.7.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.7.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.7.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.8 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.9 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant

materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.10 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.11 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.12 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

1.13 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, CEC, and requirements specified herein.

1.14 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work

week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

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SECTION 26 05 00.00 40

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 SUMMARY

This section covers common to all electrical sections.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM D 709	Laminated Thermosetting Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 480	Toggle Switches

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.12.28	Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE Stds Dictionary	IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1	Accessible and Usable Buildings and Facilities

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI Z535.1	American National Standard for Safety--Color Code

ANSI/NEMA FB 1	Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
ANSI/NEMA OS 1	Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA KS 1	Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA PB 1	Panelboards
NEMA RN 1	Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA WD 1	Standard for General Color Requirements for Wiring Devices
NEMA WD 6	Wiring Devices Dimensions Specifications

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1	Standard for Flexible Metal Conduit
UL 1242	Standard for Electrical Intermediate Metal Conduit -- Steel
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 506	Specialty Transformers
UL 6	Electrical Rigid Metal Conduit-Steel
UL 797	Electrical Metallic Tubing -- Steel
UL 870	Standard for Wireways, Auxiliary Gutters, and Associated Fittings

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as

defined in IEEE Stds Dictionary.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. Vertical assembly: A vertical assembly is a pole, tower or other such support, mounting hardware, arms, brackets and the load. Load can be a luminaire, siten, loudspeaker or other device. All components of a vertical assembly will be rated by the manufacturer to withstand 135 mph wind loading.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixture Lists for the following:

Conduits, Raceway sand Fittings

Wire and Cable

Splices and Connectors

Switches

Receptacles

Outlets, Outlet Boxes, and Pull Boxes

Circuit Breakers

Panelboards

Lamps and Lighting Fixtures

Dry-Type Distribution Transformers

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Conduits, Raceway sand Fittings

Wire and Cable

Splices and Connectors

Switches

Receptacles

Outlets, Outlet Boxes, and Pull Boxes

Circuit Breakers

Panelboards

Lamps and Lighting Fixtures

Dry-Type Distribution Transformers

Spare Parts

Certification

Submittal for vertical assemblies will be reviewed by a licensed Mechanical, Civil or Structural Engineer to determine that the entire assembly will withstand 135 mph wind loading.

SD-06 Test Reports

Continuity Test

Phase-Rotation Tests

Insulation Resistance Test

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions.

1.5 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.6 PREVENTION OF CORROSION

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by approved fittings and treatment. Ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous spare parts not of corrosion-resistant steel shall be hot-dip galvanized except where other equivalent protective treatment is specifically approved in writing.

1.7 GENERAL REQUIREMENTS

Submit material, equipment, and fixture lists for the following items

showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Submit manufacturer's instructions including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

Submit certification required to install equipment components and system packages.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and be secured to prevent easy removal or peeling.

1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.11 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators,

and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

PART 2 PRODUCTS

2.1 MATERIALS

Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

2.1.1 Rigid Steel Conduit

Rigid steel conduit shall comply with UL 6 and be galvanized by the hot-dip process. Rigid steel conduit shall be polyvinylchloride (PVC) coated in accordance with NEMA RN 1, where underground and in corrosive areas, or must be painted with bitumastic.

Fittings for rigid steel conduit shall be threaded.

Gaskets shall be solid. Conduit fittings with blank covers shall have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Covers shall have captive screws and be accessible after the work has been completed.

2.1.2 Electrical Metallic Tubing (EMT)

EMT shall be in accordance with UL 797 and be zinc coated steel. Couplings and connectors shall be zinc-coated, raintight, gland compression with insulation throat. Crimp, spring, or setscrew type fittings are not acceptable.

2.1.3 Flexible Metallic Conduit

Flexible metallic conduit shall comply with UL 1 and be galvanized steel.

Fittings for flexible metallic conduit shall be specifically designed for such conduit.

Provide liquidtight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Specifically design fittings for liquidtight flexible metallic conduit for such conduit.

2.1.4 Intermediate Metal Conduit

Intermediate metal conduit shall comply with UL 1242 and be galvanized.

2.1.5 Rigid Nonmetallic Conduit

Rigid nonmetallic conduit shall comply with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 40.

2.1.6 Wireways and Auxiliary Gutters

Wireway and auxiliary gutters shall be a minimum 4- by 4 inch trade size conforming to UL 870.

2.1.7 Surface Raceways and Assemblies

Surface metal raceways and multi-outlet assemblies shall conform to CEC. Receptacles shall conform to NEMA WD 1, Type 5-20R.

2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 600-volt type THHN or THWN. All conductors AWG No. 8 and larger, shall be stranded. All conductors smaller than AWG No. 8 shall be solid.

Flexible cable shall be Type SO and contain a grounding conductor with green insulation.

Conductors installed in plenums shall be marked plenum rated.

2.3 SPLICES AND CONNECTORS

Make all splices in AWG No. 8 and smaller with approved insulated electrical type.

Make all splices in AWG No. 6 and larger with indentor crimp-type connectors and compression tools. Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

2.4 SWITCHES

2.4.1 Safety Switches

Safety switches shall comply with NEMA KS 1, and be the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing as indicated. Switch construction shall be such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device shall be coinproof and be so constructed that an external tool shall be used to open the cover. Make provisions to lock the handle in the "OFF" position, but the switch shall not be capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type. Approve terminal lugs for use with copper conductors.

Safety color coding for identification of safety switches shall conform to ANSI Z535.1.

2.4.2 Toggle Switches

Toggle switches shall comply with EIA 480, control incandescent, mercury, and fluorescent lighting fixtures and be of the heavy duty, general purpose, noninterchangeable flush-type.

Toggle switches shall be commercial grade toggle type, single and double -pole, three-way two-position devices rated 20 amperes at 277 volts, 60 hertz alternating current (ac) only.

All toggle switches shall be products of the same manufacturer.

2.5 RECEPTACLES

Receptacles shall be commercial grade, 20A, 125 VAC, 2-pole, 3-wire duplex conforming to NEMA WD 6, NEMA 5-20R.

2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES

Outlet boxes for use with conduit systems shall be in accordance with ANSI/NEMA FB 1 and ANSI/NEMA OS 1 and be not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

2.7 PANELBOARDS

Lighting and appliance branch circuit panelboards shall be the circuit-breaker type in accordance with NEMA PB 1. Bolt circuit breakers to the bus. Plug-in circuit breakers are not acceptable. Buses shall be copper of the rating indicated, with main lugs or main circuit breaker as indicated. Provide all panelboards for use on grounded ac systems with a full-capacity isolated neutral bus and a separate grounding bus bonded to the panelboard enclosure. Panelboard enclosures shall be NEMA 250, Type 1, in accordance with NEMA PB 1. Provide enclosure fronts with latchable hinged doors.

2.8 CIRCUIT BREAKERS

Circuit-breaker interrupting rating shall be not less than those indicated and in no event less than 10,000 amperes root-mean-square (rms) symmetrical at 208 volts, respectively. Multipole circuit breakers shall be the common-trip type with a single handle. Molded case circuit breakers shall be bolt-on type conforming to UL 489.

2.9 LAMPS AND LIGHTING FIXTURES

Manufacturers and catalog numbers shown are indicative of the general type desited and are not intended to restrict the selection to fixtures of any particular manufacturer. Fixtures with the same salient features and equivalent light distribution and brightness characteristics, of equal finish and quality, are acceptable. Provide lamps of the proper type and wattage for each fixture.

Ballasts shall be high power factor and be energy efficient. Ballasts shall have a Class P terminal protective device for 277-volt operation as indicated and be rapid-start fluorescent. Ballasts shall be "A" sound rated. Fluorescent lamps shall be standard reduced wattage type.

2.10 DRY-TYPE DISTRIBUTION TRANSFORMERS

General purpose dry-type transformers with windings 600 volts or less shall be two-winding, 60 hertz, self-cooled in accordance with UL 506. Windings shall have a minimum of two 2-1/2-percent taps above and below nominal voltage.

PART 3 EXECUTION

3.1 CONDUITS, RACEWAYS AND FITTINGS

Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or be replaced.

Conduit and raceway runs concealed in or behind walls, above ceilings, or exposed on walls and ceilings 5 feet or more above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

3.1.1 Rigid Steel Conduit

Make field-made bends and offsets with approved hickey or conduit bending machine. Conduit elbows larger than 2-1/2 inches shall be long radius.

Provide all conduit stubbed-up through concrete floors for connections to free-standing equipment with the exception of motor-control centers, cubicles, and other such items of equipment, with a flush coupling when the floor slab is of sufficient thickness. Otherwise,provide a floor box set flush with the finished floor. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.

3.1.2 Electrical Metallic Tubing (EMT)

EMT shall be grounded in accordance with CEC, using pressure grounding connectors especially designed for EMT.

3.1.3 Flexible Metallic Conduit

Use flexible metallic conduit to connect recessed fixtures from outlet boxes in ceilings, transformers, and other approved assemblies.

Bonding wires shall be used in flexible conduit as specified in CEC, for all circuits. Flexible conduit shall not be considered a ground conductor.

Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit.

Liquidtight flexible metallic conduit shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

3.1.4 Intermediate Conduit

Make all field-made bends and offsets with approved hickey or conduit bending machine. Use intermediate metal conduit only for indoor installations.

3.1.5 Rigid Nonmetallic Conduit

Rigid PVC conduit shall be direct buried.

A green insulated copper grounding conductor shall be in conduit with conductors and be solidly connected to ground at each end. Grounding wires shall be sized in accordance with CEC.

3.1.6 Wireway and Auxiliary Gutter

Straight sections and fittings shall be bolted together to provide a rigid, mechanical connection and electrical continuity. Dead ends of wireways and auxiliary gutters shall be closed. Plug all unused conduit openings.

Wireways for overhead distribution and control circuits shall be supported at maximum 5-foot intervals.

Auxiliary gutters used to supplement wiring spaces for equipment not contained in a single enclosure shall contain no switches, overcurrent devices, appliances, or apparatus and be not more than 30 feet long.

3.1.7 Surface Raceways and Assemblies

Surface raceways shall be mounted plumb and level, with the base and cover secured. Minimum circuit run shall be three-wire with one wire designated as ground.

3.2 WIRING

Feeder and branch circuit conductors shall be color coded as follows:

CONDUCTOR	COLOR AC 120/208V		COLOR AC 277/480V
Phase A	Black		Brown
Phase B	Red		Orange
Phase C	Blue		Yellow
Neutral	White		White
Equipment Grounds	Green	or	Bare

Conductors up to and including AWG No. 2 shall be manufactured with colored insulating materials. Conductors larger than AWG No. 2 shall have ends identified with color plastic tape in outlet, pull, or junction boxes.

Splice in accordance with the CEC. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match as indicated.

Where several feeders pass through a common pullbox, the feeders shall be

tagged to clearly indicate the electrical characteristics, circuit number, and panel designation.

3.3 SAFETY SWITCHES

Securely fasten switches to the supporting structure or wall, utilizing a minimum of four 1/4 inch bolts. Do not use sheet metal screws and small machine screws for mounting. Do not mount switches in an inaccessible location or where the passageway to the switch may become obstructed. Mounting height shall be 5 feet above floor level, when possible.

3.4 WIRING DEVICES

3.4.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates will be aligned vertically to within 1/16 inch.

Ground terminal of each flush-mounted receptacle shall be bonded to the outlet box with an approved green bonding jumper when used with dry wall type construction.

3.4.2 Device Plates

Device plates for switches that are not within sight of the loads controlled shall be suitably engraved with a description of the loads.

Device plates and receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets shall be suitably marked, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Required marking shall consist of a self-adhesive label having 1/4 inch embossed letters.

Device plates for convenience outlets shall be similarly marked indicating the supply panel and circuit number.

3.5 BOXES AND FITTINGS

Furnish and install pullboxes where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right-angle bends shall have a pullbox installed at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

Mounting height of wall-mounted outlet and switch boxes, measured between the bottom of the box and the finished floor, shall be in accordance with ICC/ANSI A117.1 and as follows:

LOCATION	MOUNTING HEIGHT
Receptacles in offices	18 inches
Receptacles in corridors	18 inches
Receptacles in shops and laboratories	48 inches

LOCATION	MOUNTING HEIGHT
Receptacles in rest rooms	48 inches
Switches for light control	48 inches

3.6 LAMPS AND LIGHTING FIXTURES

Install new lamps of the proper type and wattage in each fixture. Securely fasten fixtures and supports to structural members and install parallel and perpendicular to major axes of structures.

3.7 PANELBOARDS

Securely mount panelboards so that the top operating handle does not exceed 72-inches above the finished floor. Do not mount equipment within 36 inches of the front of the panel. Directory card information shall be complete and legible.

3.8 DRY-TYPE DISTRIBUTION TRANSFORMERS

Connect dry-type transformers with flexible metallic conduit.

Mount all dry-type transformers on vibration isolators in accordance with Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT.

3.9 IDENTIFICATION PLATES AND WARNINGS

Furnish and install identification plates for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, door bells, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Process control devices and pilot lights shall have identification plates.

Furnish identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. Circuits 480 volts and above shall have conspicuously located warning signs in accordance with OSHA requirements.

3.10 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted as specified in Section 09 90 00 PAINTS AND COATINGS.

3.11 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Submit Test Reports in accordance with referenced standards in this section.

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Contractor shall provide all necessary test equipment, labor, and personnel

to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices shall be used to isolate the circuits under test.

Perform insulation-resistance test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes 8AWG and smaller insulation resistance testing is not required.

Perform continuity test to insure correct cable connection (i.e correct phase conductor, grounded conductor, and grounding conductor wiring) end-to end. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at contractor's expense. All repairs shall be approved by the CO prior to acceptance of the repair.

Conduct phase-rotation tests on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment clockwise, facing the source.

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the CO.

-- End of Section --

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DIVISION 26 - ELECTRICAL

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SECTION 26 05 13.00 40

MEDIUM-VOLTAGE CABLES

PART 1 GENERAL

1.1 SUMMARY

This section covers medium voltage cables, including shielded and nonshielded single-and multiple-conductor power cables, portable cables, cable splices and terminations, single- and multiple-conductor potheads, and fireproofing cables in manholes and utility tunnels.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8	Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV
AEIC CS1	Impregnated-Paper-Insulated, Metallic Sheathed Cable, Solid Type

ASTM INTERNATIONAL (ASTM)

ASTM B 3	Standard Specification for Soft or Annealed Copper Wire
ASTM D 746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 400.2	Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 71/ICEA S-96-659	Standard for Nonshielded Cables Rated

	2001-5000 Volts for use in the Distribution of Electric Energy
NEMA WC 70	Power Cable Rated 2000 V or Less for the Distribution of Electrical Energy--S95-658
NEMA WC 74/ICEA S-93-639	5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-228	Cable and Wire, Insulated; Methods of Testing

1.3 DEFINITIONS

Medium voltage power cables includes all cables rated above 600 to 35,000 volts.

1.4 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Provide Certificates for the following showing that the cable manufacturer has made factory-conducted tests on each shipping length of cable. Provide certified copies of test data that shows conformance with the referenced standards and is approved prior to delivery of cable.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Provide equipment and performance data and manufacturer's catalog data for the following items:

Multiple-Conductor Shielded Cables

Multiple-Conductor Nonshielded Cables

Single-Conductor Shielded Cables

Single-Conductor Nonshielded Cables

Portable Cables

Nonmetallic Jacket

SD-06 Test Reports

Provide test reports for the following in accordance with the

paragraph entitled, "Field Testing," of this section.

Dielectric Absorption Tests

High-Voltage Tests

Radiographic Tests

SD-07 Certificates

Provide listing of products installed showing qualifications of Cable Splicers to the COR prior to specified work.

Provide Certificates for the following:

Lead Sheath

Flammability

Minimum Bending Radius

High-Voltage Tests

Dielectric Absorption Tests

Cable Splicers

SD-08 Manufacturer's Instructions

Provide manufacturer's instructions showing the recommended sequence and method of installation for the following:

Medium-Voltage Power Cables

High-Voltage Power Cables

Pothead Terminations

1.6 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.7 QUALIFICATIONS

Cable splicers performing splicing are required to have 5 years experience in cable splicing and terminations. Once a termination or splice has been started by a worker, the same person completes that particular splice. Start and complete each termination and splice in one continuous work

period.

1.8 CABLE VOLTAGE RATINGS

Provide Medium-voltage power cables including multiple- and single-conductor cables rated as follows, phase-to-phase, for grounded and ungrounded neutral systems:

Use cables rated 15,000 volts, ungrounded neutral, on three-phase, 60-hertz distribution systems.

1.9 SHIPMENT

Ship cables on reels such that the cable is protected from mechanical injury. Hermetically seal and securely attach each end of each length of cable to the reel.

Make minimum reel drum diameter 14 times the overall diameter of the cable. Provide a pulling eye that is installed by the manufacturer for each length of cable supplied for installation in ducts, manholes, and utility tunnels.

PART 2 PRODUCTS

2.1 CONDUCTORS

Provide conductors that are solid copper conforming to ASTM B 3.

2.2 CABLE IDENTIFICATION

Provide cables that have a tape placed immediately under the lead sheath or outer jacket showing the name of the manufacturer, the year in which the cable was manufactured, and a unique number for identification purposes. Closely group information on the tape at 1-foot intervals to permit complete identification.

2.3 FLAMMABILITY

Test cables not to be enclosed in metallic conduit for flammability in accordance with FED-STD-228, Method 5221 vertical, spark 70,000 Btu per hour per hour vertical tray flame test.

2.4 MULTIPLE-CONDUCTOR SHIELDED CABLES

2.4.1 Ethylene Propylene Rubber (EPR) with Jacketed Interlocked Armor

Provide multiple-conductor ethylene propylene rubber insulated interlocked armor covered shielded cables that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

Shield ethylene propylene (EP) or ethylene propylene rubber (EPR), single- and multiple-conductor cables for grounded or ungrounded neutral voltage ratings of more that 8,000 volts.

2.5 SINGLE-CONDUCTOR SHIELDED CABLES

2.5.1 Ethylene-Propylene-Rubber-Insulated with PVC Jacket

Provide single-conductor 15 KV cable assemblies that consist of: Class B

stranded copper conductors, an extruded semiconducting shield over the conductors, 220 mils of ethylene propylene rubber insulation, an extruded or other approved semiconducting shield, a 5 mil minimum copper tape shield wrapped helically with a minimum 12.5 percent overlap and a PVC jacket.

Provide single-conductor, ethylene-propylene-insulated, polyvinylchloride-jacketed, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.6 CABLE SUPPORTS AND FITTINGS

Provide cable supports, related fittings, and accessories for use in corrosive underground locations, such as manholes and utility tunnels, with a factory applied coating of polyvinylchloride of at least 20 mils thick. Provide polyvinylchloride (PVC) coated items that have a uniform thickness and be free of blisters, breaks, and holidays. Provide PVC compound that conforms to ASTM D 746.

PART 3 EXECUTION

3.1 INSTALLATION

Install medium-voltage cables in accordance with CEC.

Install cable in underground duct banks; in conduit above and below grade; inside buildings; by open wire method; on insulator hooks; on racks; in wall and ceiling mounted cable trays in utility tunnels and manholes; and by direct burial.

Secure cables with heavy duty cable ties in existing or new trays mounted horizontally, where cable rests on tray bottom. Install cable ties at minimum of 10foot intervals.

Secure cables with PVC coated cable clamps, straps, hangers, or other approved supporting devices to tunnel walls, ceilings, and in new or existing cable trays mounted vertically, where tray bottom is in a vertical plane.

When field cuts or other damage occurs to the PVC coating, apply a liquid PVC patch to maintain the integrity of the coating. After the installation is complete, perform an inspection to ensure the absence of voids, pinholes, or cuts.

Ensure that all cable tray is properly secured and supported prior to installing new armored cable. Add new permanent and/or temporary tray support devices as required to preclude cable tray failure during cable pulling or after cable is installed.

Cable or conductors of a primary distribution system will be rejected when installed openly in cable trays or openly racked along interior walls; in the same raceway or conduit with ac/dc control circuits or ac power circuits operating at less than 600 volts; or in a manner allowing cable to support its own weight.

3.1.1 Moisture-Testing Before Pulling

Moisture-test cable that has paper insulation before before pulling it into underground ducts. Ensure that radii of bends, potheads, fittings, cable risers, and other conditions are suitable for the cable and conform with

the recommendations of the cable manufacturer.

3.1.2 Protection During Splicing Operations

Provide blower to force fresh air into manholes or confined areas where free movement or circulation of air is obstructed. Make waterproof protective coverings available on the work site to provide protection against moisture while a splice is being made. Use pumps to keep manholes dry during splicing operations. Never make a splice or termination with the interior of a cable exposed to moisture. Moisture-test conductor insulation paper before the splice is made. Use a manhole ring at least 6 -inches above ground around the manhole entrance to keep surface water from entering the manhole. Plug unused ducts and stop water seepage through ducts in use before the splice is started.

3.1.3 Duct Cleaning

Thoroughly clean ducts before installation of power cables. Pull a standard flexible mandrel through each duct to loosen particles of earth, sand, or foreign material in the line. Provide not less than 12-inches long mandrel with a diameter 1/2 inch less than the inside diameter of the duct. Then pull a brush with stiff bristles through each duct to remove the loosened particles. Provide brush diameter that is the same as or slightly larger than the diameter of the duct.

3.1.4 Pulling Cables in Ducts, Manholes and Utility Tunnels

Pull medium-voltage cables into ducts and utility tunnels with equipment designed for this purpose, including power-driven winch, cable-feeding flexible tube guide, cable grips, and lubricants. Employ a sufficient number of trained personnel and equipment to ensure the careful and proper installation of the cable.

Set up cable reel at the side of the manhole or tunnel hatch opening and above the duct or hatch level, allowing the cable to enter through the opening without reverse bending. Install flexible tube guide through the opening in a manner that prevents the cable from rubbing on the edges of any structural member.

Allow for a pulling force for a cable grip on lead-sheathed cable that does not exceed 1,500 pounds per square inch of sheath cross-sectional area. Use a dynamometer in the pulling line to ensure that the pulling force is not exceeded. Allow for a pulling force for a nonmetallic-sheathed cable that does not exceed the smaller of 1,000 pounds or a value computed from the following equation:

$$TM = 0.008 \times N \times CM$$

Where: TM = maximum allowable pulling tension in pounds

N = number of conductors in the cable

CM = cross-sectional area of each conductor in circular mils

Unreel cable from the top of the reel. Carefully control payout. Make cable to be pulled be attached through a swivel to the main pulling wire by means of a suitable cable grip permitted only on cables less than 200-feet long and less than 2 inches in diameter.

Use woven-wire cable grips to grip the cable end when pulling small cables and short straight lengths of heavier cables.

Attach pulling eyes to the cable conductors to prevent damage to the cable structure.

Use pulling eyes and cable grips together for nonmetallic sheathed cables to prevent damage to the cable structure.

Provide a minimum bending radius in accordance with the following:

CABLE TYPE	MINIMUM BENDING RADIUS MULTIPLIER TIMES CABLE DIAMETER
RUBBER- AND PLASTIC-INSULATED CABLE WITH OR WITHOUT INTERLOCKED ARMOR	
Shielded cables with shielding tape	12
Shielded cables with shielding wire	8
PAPER-INSULATED AND LEAD-COVERED CABLES, SHIELDED OR NONSHIELDED	
Cables without armor	10
Cables with wire armor	12
VARNISHED-CAMBRIC-INSULATED CABLES WITH OR WITHOUT LEAD SHEATH, SHIELDED OR NONSHIELDED	
Cables without armor	8
Cables with wire armor	12

Liberally coat cables with a suitable cable-pulling lubricant as it enters the tube guide or duct. Use grease and oil lubricants only on lead-sheathed cables. Cover nonmetallic sheathed cables with wire-pulling compounds when required which have no deleterious effects on the cable. Provide rollers, sheaves, or tube guides around which the cable is pulled that conform to the minimum bending radius of the cable.

Pull cables into ducts at a speed not to exceed 50 feet per minute and not in excess of maximum permissible pulling tension specified by the cable manufacturer. Cable pulling using a vehicle is not permitted. Stop pulling operations immediately with any indication of binding or obstruction and do not resume until such difficulty is corrected. Provide sufficient slack for free movement of cable due to expansion or contraction.

Make cable splices made up in manholes or utility tunnels that are firmly supported on cable racks as indicated. Do not pull cable splices in ducts. Overlap cable ends at the ends of a section to provide sufficient undamaged cable for splicing. Make cables to be spliced in manholes or

utility tunnels overlap the centerline of the proposed joint by not less than 2 feet.

Provide cables cut in the field that have the cut ends immediately sealed to prevent entrance of moisture. Seal nonleaded cables with rubber tape wrapped down to 3 inches from the cable end. Cover-wrap rubber tape with polyvinylchloride tape. Seal lead-covered cables with wiping metal making a firm bond with the end of the sheath or with a disk of lead fitted over the end and wiped to the sheath.

3.1.5 Splices and Terminations

Make splices in manholes or tunnels except where cable terminations are specifically indicated. Expedite splicing and terminating of cables to minimize exposure and cable deterioration.

Terminate cables in potheads. Dry terminations with medium voltage pennants, preformed, and hand wrapped stress cones are allowed for terminating cables. Provide potheads with adequate means for making external connections to the cable conductors of single-conductor cables; protecting the cable insulation against moisture, oil, or other contaminant; physically protecting and supporting cables, and maintaining the insulation level of the cable.

Field-fabricate Pothead terminations from termination kits supplied by and in accordance with the pothead manufacturer's recommendations for the type, size, and electrical characteristics of the cable.

Installation includes built-up or prefabricated heat or cold shrink stress-relief cones at the terminals of all shielded cables and at the terminals of single-conductor lead-covered cables rated 15 kV and above, ungrounded.

Field fabricate cable splices from splicing kits supplied by and in accordance with the cable manufacturer's recommendations for the type, size, and electrical characteristics of the cable specified. Locate cable splices in manholes midway between cable racks on walls of manholes and supported with cable arms at approximately the same elevation as the enclosing duct.

Cable splices in the tunnel which are not installed in cable trays, install on cable racks or by other approved methods which minimize physical stress on the splice connections. Support splices at approximately the same elevation as the installed cable except where space limitations or existing cable length limitations make this method impractical or impossible.

Support all universal demountable splices in such manner so as to minimize physical stress on the splice connections. Support each cable end termination using a pair of saddle type supports under the cable end termination and/or cable with a minimum 12 inches and a maximum 30 inches separation between the supports. Secure cable end termination and cable to the supports in such a manner as to prevent movement of termination or cable at the support. Install saddle type supports on galvanized steel framing channel anchored to the wall or securely fastened to the cable tray or installed by other approved methods.

3.1.6 Multiple-Conductor Potheads

Provide multiple-conductor potheads that are hermetically sealed capnut

type and that are suitable for the type, size, and electrical characteristics of the cable. Provide potheads that consist of bells or bodies with bell caps, bushing, cable connectors, lugs, and entrance fittings.

Provide pothead bells or bodies that are cast iron with mounting brackets as required, pipe plugs for fillings and vent holes, machine-flanged surfaces for bell caps, and cable entrance fittings. Provide pothead bell caps for cables up to 250 kc mils 250 amperes that are cast aluminum; and for cables of larger size and higher current ratings that are cast aluminum. Provide bell caps that have matching machined flanged surfaces for sealing with gasket and cap-screw connections.

Provide bushings that are glazed wet-process electrical porcelain insulators, factory assembled and hermetically sealed to bell cap.

Provide cable connectors that are high-conductivity copper accurately machined and threaded for internal and external electrical connections. Provide cross-sectional and contact areas that are adequate to carry the full-load current rating of the conductors. Provide solder type cable connectors with gasket seal between the connector and bushing.

Provide cable-entrance fittings that are cast-bronze wiping-sleeve type for lead-covered cable, and cast-aluminum positive-sealed stuffing boxes for nonlead-covered cables. Provide cast iron conduit couplings and armor base fittings.

Three-conductor potheads with a neutral stud and lug are allowed in lieu of four-conductor potheads in four-wire grounded neutral systems.

Provide completely filled potheads, leaving no gaps or voids, with an insulating compound suitable for the type of cable, insulation, voltage rating, and ambient operating temperatures in accordance with the pothead manufacturer's recommendations. Ground pothead parts that do not carry current.

3.1.7 Single-Conductor Potheads

Provide single-conductor potheads that are the hermetically sealed capnut type and that are suitable for the type, size, and electrical characteristics of the cable specified. Provide potheads that consist of cast bodies, bushings, cable connectors, lugs, and entrance fittings.

Provide pothead bodies that are metal castings with mounting brackets, when required, pipe plugs for filling and vent holes, and machined flanged surface for cable-entrance fitting. Provide bodies that are cast iron for cables up to 250 kc mils 250 amperes, and cast aluminum for cable of larger size and higher current ratings.

Provide bushings that are glazed wet-process electrical porcelain insulators, factory assembled and hermetically sealed to the pothead body.

Provide cable connectors that are high-conductivity copper accurately machined and threaded for internal and external electrical connections. Provide adequate cross-sectional and contact areas to carry the full-load current rating of the conductors. Provide solder type cable connectors with gasket seal between the connector and bushing.

Completely fill potheads, leaving no gaps or voids, with an insulating

compound suitable for the type of cable, insulation, voltage rating, and ambient operating temperatures in accordance with the pothead manufacturer's recommendations. Ground pothead parts that do not carry current.

3.2 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Subject each to dielectric-absorption tests and high-voltage tests after the installation of high-voltage power cables has been completed, including splices, joints, and terminations, and before the cable is energized.

Provide test equipment, labor, and technical personnel as necessary to perform the electrical acceptance tests.

Make arrangements to have tests witnessed and approved by the COR.

Completely isolate each power-cable installation from extraneous electrical connections at cable terminations and joints. Observe safety precautions.

First give each power cable a full dielectric-absorption test with 5000-volt insulation-resistance test set. Apply test for a long enough time to fully charge the cable. Record readings every 15 seconds during the first 3 minutes of test and at 1 minute intervals thereafter. Continue test until three equal readings, 1 minute apart, are obtained. Minimum reading is 200 megohms at an ambient temperature of 68 degrees F. Correct readings taken at other than 68 degrees F ambient temperatures.

Upon successful completion of the dielectric absorption tests, subject the cable to a direct-current high-potential test for 5 minutes with test voltages applied in accordance with AEIC CS1 and IEEE 400.2 for paper-impregnated, lead-covered cable; AEIC C8 and IEEE 400.2 for cross-linked, polyethylene-insulated cable; and AEIC C8 and IEEE 400.2 for ethylene propylene rubber-insulated cable.

Record leakage current readings every 30 seconds during the first 2 minutes and every minute thereafter for the remainder of the test. When the leakage current continues to increase after the first minute, immediately terminate the test and take steps to find and correct the fault. When a second test becomes necessary, repeat this test procedure.

Upon satisfactory completion of the high-potential test, give the cable a second dielectric-absorption test as before.

Provide results of the second dielectric-absorption test that agree with the first test and that indicate no evidence of permanent injury to the cable caused by the high-potential test.

Record test data and include identification of cable and location, megohm readings versus time, leakage current readings versus time, and cable temperature versus time.

Final acceptance depends upon the satisfactory performance of the cable under test. Do not energize cable until recorded test data has been approved by the COR Provide final test reports to the COR. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Report - Forward to the Systems

Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

Perform Radiographic tests on all potheads at the discretion of the COR to determine if voids exist in the pothead. Rework unacceptable terminations at no additional expense to the Government.

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INSULATED WIRE AND CABLE

PART 1 GENERAL

1.1 SUMMARY

This section covers insulated wire and cable for use on hydraulic structures, except for wire and cable for special applications, such as low-level circuits for analog signals, data and supervisory control, communication and telemetering systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8	Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV
AEIC CS8	Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 383	Standard for Qualifying Class 1E Electric Cables and, Field Splices for Nuclear Power Generating Stations 2004

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 70	Power Cable Rated 2000 V or Less for the Distribution of Electrical Energy--S95-658

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Installation Instructions

Cable manufacturing data.

SD-06 Test Reports

Tests, Inspections, and Verifications

Six certified copies of test reports.

1.4 DELIVERY, STORAGE, AND HANDLING

Furnish cables on reels or coils. Each cable and the outside of each reel or coil, shall be plainly marked or tagged to indicate the cable length, voltage rating, conductor size, and manufacturer's lot number and reel number. Each coil or reel of cable shall contain only one continuous cable without splices. Cables for exclusively dc applications, as specified in paragraph HIGH VOLTAGE TEST SOURCE, shall be identified as such. Shielded cables rated 2,001 volts and above shall be reeled and marked in accordance with Section I of AEIC C8 or AEIC CS8, as applicable. Reels shall remain the property of the Government.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Wire Table

Furnish wire and cable in accordance with the requirements of the wire table appended to these specifications, conforming to the detailed requirements specified herein.

2.1.2 Rated Circuit Voltages

All wire and cable shall have minimum rated circuit voltages in accordance with NEMA WC 70.

2.1.3 Conductors

2.1.3.1 Material for Conductors

Conductors shall conform to all the applicable requirements of NEMA WC 70, as applicable, and shall be annealed copper. Copper conductors may be bare, or tin- or lead-alloy-coated, if required by the type of insulation used.

2.1.3.2 Size

Minimum wire size shall be No. 12 AWG for power and lighting circuits; No. 10 AWG for current transformer secondary circuits; No. 14 AWG for potential transformer, relaying, and control circuits; No. 16 AWG for annunciator circuits; and No. 19 AWG for alarm circuits. Minimum wire sizes for rated circuit voltages of 2,001 volts and above shall not be less than those listed for the applicable voltage in NEMA WC 70, as applicable.

2.1.3.3 Stranding

Conductor stranding classes cited herein shall be as defined in NEMA WC 70, as applicable. Lighting conductors No. 10 AWG and smaller shall be solid or have Class B stranding. Any conductors used between stationary and moving devices, such as hinged doors or panels, shall have Class H or K stranding. All other conductors shall have Class B or C stranding, except that conductors shown on the drawings, or in the schedule, as No. 12 AWG may be 19 strands of No. 25 AWG, and conductors shown as No. 10 AWG may be

19 strands of No. 22 AWG.

2.1.3.4 Conductor Shielding

Use conductor shielding conforming to NEMA WC 70, as applicable, on power cables having a rated circuit voltage above 2,000 volts. In addition, conductor shielding for shielded cables shall also comply with Section C of AEIC C8 or AEIC CS8. Strict precautions shall be taken after application of the conductor shielding to prevent the inclusion of voids or contamination between the conductor shielding and the subsequently applied insulation.

2.1.3.5 Separator Tape

Where conductor shielding, strand filling, or other special conductor treatment is not required, a separator tape between conductor and insulation is permitted.

2.1.4 Insulation

2.1.4.1 Insulation Material

Provide insulation which is a cross-linked thermosetting polyethylene (XLPE) type, meeting the requirements of NEMA WC 70, as applicable, or an ethylene-propylene rubber (EPR) type meeting the requirements of NEMA WC 70. For shielded cables of rated circuit voltages above 2,000 volts, the following provisions shall also apply:

a. XLPE, if used, shall be tree-retardant.

b. Insulation shall be chemically bonded to conductor shielding.

c. The insulation material and its manufacturing, handling, extrusion and vulcanizing processes, shall all be subject to strict procedures to prevent the inclusion of voids, contamination, or other irregularities on or in the insulation. Insulation material shall be inspected for voids and contaminants. Inspection methods, and maximum allowable void and contaminant content shall be in accordance with Section B of AEIC C8 or AEIC CS8, as applicable.

d. Cables with repaired insulation defects discovered during factory testing, or with splices or insulation joints, are not acceptable unless specifically approved.

2.1.4.2 Insulation Thickness

The insulation thickness for each conductor shall be based on its rated circuit voltage.

a. Power Cables/Single-Conductor Control Cables, 2,000 Volts and Below - The insulation thickness for single-conductor cables rated 2,000 volts and below shall be as required by NEMA WC 70, as applicable. Some thicknesses of NEMA WC 70 will be permitted only for single-conductor cross-linked thermosetting polyethylene insulated cables without a jacket. NEMA WC 70 ethylene-propylene rubber-insulated conductors shall have a jacket.

b. Power Cables, Rated 2,001 Volts and Above - Thickness of insulation for power cables rated 2,001 volts and above shall be in accordance with

the following:

1. Non-shielded cables, 2,001 to 5,000 volts, shall comply with NEMA WC 70, as applicable.

2. Shielded cables rated 2,001 volts and above shall comply with Column B of Table B1, of AEIC C8 or AEIC CS8, as applicable.

c. Multiple-Conductor Control Cables - The insulation thickness of multiple-conductor cables used for control and related purposes shall be as required by NEMA WC 70, as applicable.

2.1.4.3 Insulation Shielding

Unless otherwise specified, provide insulation shielding for conductors having rated circuit voltages of 2,001 volts and above. The voltage limits above which insulation shielding is required, and the material requirements, are given in NEMA WC 70, as applicable. The material, if thermosetting, shall meet the wafer boil test requirements as described in Section D of AEIC C8 or AEIC CS8, as applicable. The method of shielding shall be in accordance with the current practice of the industry; however, the application process shall include strict precautions to prevent voids or contamination between the insulation and the nonmetallic component. Voids, protrusions, and indentations of the shield shall not exceed the maximum allowances specified in Section C of AEIC C8 or AEIC CS8, as applicable. The cable shall be capable of operating without damage or excessive temperature when the shield is grounded at both ends of each conductor. All components of the shielding system shall remain tightly applied to the components they enclose after handling and installation in accordance with the manufacturer's recommendations. Shielding systems which require heat to remove will not be permitted unless specifically approved.

2.1.5 Jackets

All cables shall have jackets meeting the requirements of NEMA WC 70, as applicable, and as specified herein. Individual conductors of multiple-conductor cables shall be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, shall be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables shall be provided with a common overall jacket, which shall be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

2.1.5.1 Jacket Material

The jacket shall be one of the materials listed below. Polyvinyl chloride compounds will not be permitted. Variations from the materials required below will be permitted only if approved for each specific use, upon submittal of sufficient data to prove that they exceed all specified requirements for the particular application.

a. General Use

1. Heavy-duty black neoprene (NEMA WC 70).

2. Heavy-duty chlorosulfonated polyethylene (NEMA WC 70).

3. Heavy-duty cross-linked (thermoset) chlorinated polyethylene (NEMA WC 70).

b. Accessible Use Only, 2,000 Volts or Less - Cables installed where they are entirely accessible, such as cable trays and raceways with removable covers, or where they pass through less than 10 feet of exposed conduit only, shall have jackets of one of the materials specified in above paragraph GENERAL USE, or the jackets may be of one of the following:

1. General-purpose neoprene (NEMA WC 70).

2. Black polyethylene (NEMA WC 70).

3. Thermoplastic chlorinated polyethylene (NEMA WC 70).

2.1.5.2 Jacket Thickness

The minimum thickness of the jackets at any point shall be not less than 80 percent of the respective nominal thicknesses specified below.

a. Multiple-Conductor Cables - Thickness of the jackets of the individual conductors of multiple-conductor cables shall be as required by NEMA WC 70, and shall be in addition to the conductor insulation thickness required by Column B of Table 3-1 of the applicable NEMA publication for the insulation used. Thickness of the outer jackets or sheaths of the assembled multiple-conductor cables shall be as required by NEMA WC 70.

b. Single-Conductor Cables - Single-conductor cables, if nonshielded, shall have a jacket thickness as specified in NEMA WC 70. If shielded, the jacket thickness shall be in accordance with the requirements of NEMA WC 70.

2.1.6 Metal-Clad Cable

2.1.6.1 General

The metallic covering shall be corrugated metal, conforming to the applicable requirements of NEMA WC 70. If the covering is of ferrous metal, it shall be galvanized. Copper grounding conductor(s) conforming to NEMA WC 70 shall be furnished for each multiple-conductor metal-clad cable. Assembly and cabling shall be as specified in paragraph CABLING. The metallic covering shall be applied over an inner jacket or filler tape. The cable shall be assembled so that the metallic covering will be tightly bound over a firm core.

2.1.6.2 Jackets

Metal-clad cables may have a jacket under the armor, and shall have a jacket over the armor. Jackets shall comply with the requirements of NEMA WC 70. The outer jacket for the metal-clad cable may be of polyvinyl chloride only if specifically approved.

2.2 CABLE IDENTIFICATION

2.2.1 Color-Coding

Insulation of individual conductors of multiple-conductor cables shall be color-coded in accordance with NEMA WC 70, except that colored braids will not be permitted. Only one color-code method shall be used for each cable construction type. Control cable color-coding shall be in accordance with NEMA WC 70 as follows: Power cable color-coding shall be black for Phase A, red for Phase B, blue for Phase C, white for grounded neutral, and green for an insulated grounding conductor, if included.

2.2.2 Shielded Cables Rated 2,001 Volts and Above

Marking shall be in accordance with Section H of AEIC C8 or AEIC CS8, as applicable.

2.2.3 Cabling

Individual conductors of multiple-conductor cables shall be assembled with flame-and moisture-resistant fillers, binders, and a lay conforming to NEMA WC 70, except that flat twin cables will not be permitted. Fillers shall be used in the interstices of multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross section. Fillers shall be non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber-filled or other approved type of binding tape shall consist of a material that is compatible with the other components of the cable and shall be lapped at least 10 percent of its width.

2.2.4 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables shall not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

The following information shall be provided by the cable manufacturer for each size, conductor quantity, and type of cable furnished:

a. Minimum bending radius, in inches - For multiple-conductor cables, this information shall be provided for both the individual conductors and the multiple-conductor cable.

b. Pulling tension and sidewall pressure limits, in pounds.

c. Instructions for stripping semiconducting insulation shields, if furnished, with minimum effort without damaging the insulation.

d. Upon request, compatibility of cable materials and construction with specific materials and hardware manufactured by others shall be stated. Also, if requested, recommendations shall be provided for various cable operations, including installing, splicing, terminating, etc.

3.2 TESTS, INSPECTIONS, AND VERIFICATIONS

3.2.1 Cable Data

Manufacture of the wire and cable shall not be started until all materials to be used in the fabrication of the finished wire or cable have been approved by the COR. Cable data shall be submitted for approval including dimensioned sketches showing cable construction, and sufficient additional data to show that these specifications will be satisfied.

3.2.2 Inspection and Tests

Inspection and tests of wire and cable furnished under these specifications shall be made by and at the plant of the manufacturer, and shall be witnessed by the COR or his authorized representative, unless waived in writing. The Government may perform further tests before or after installation. Testing in general shall comply with NEMA WC 70. Specific tests required for particular materials, components, and completed cables shall be as specified in the sections of the above standards applicable to those materials, components, and cable types. Tests shall also be performed in accordance with the additional requirements specified below.

3.2.2.1 High-Voltage Test Source

Where the applicable standards allow a choice, high-voltage tests for cables to be used exclusively on dc circuits shall be made with dc test voltages. Cables to be used exclusively on ac circuits shall be tested with ac test voltages. If both ac and dc will be present, on either the same or separate conductors of the cable, ac test voltages shall be used.

3.2.2.2 Shielded Cables Rated 2,001 Volts or Greater

The following tests shall be performed in addition to those specified above. Section or paragraph references are to AEIC C8 or AEIC CS8 as applicable, unless otherwise stated.

a. High potential test voltages shall be as required by Table B1 of AEIC C8 or AEIC CS8 as applicable, rather than by NEMA WC 70.

b. If high potential testing is done with an ac test voltage as specified in paragraph HIGH-VOLTAGE TEST SOURCE, an additional test shall be made using a dc test voltage rated at 75 percent of the specified full dc test voltage, for 5 consecutive minutes.

c. Production sampling tests shall be performed in accordance with Section D. Sampling frequency and failure contingencies shall be in accordance with paragraph G.3. Unless otherwise approved, samples shall not be taken from the middle of extruder runs of insulation or shielding made only for one continuous shipping length of cable, if such sampling will result in the need to repair the sampled area.

d. Partial discharge tests shall be performed in accordance with Section E, paragraph E.2, and Section F.

3.2.2.3 Flame Tests

All multiple-conductor and single-conductor cable assemblies shall pass IEEE 383 flame tests, paragraph 2.5, using the ribbon gas burner. Single-conductor cables and individual conductors of multiple-conductor

cables shall pass the flame test of NEMA WC 70. If such tests, however, have previously been made on identical cables, these tests need not be repeated. Instead, certified reports of the original qualifying tests shall be submitted. In this case the reports furnished under paragraph REPORTS, shall verify that all of each cable's materials, construction, and dimensions are the same as those in the qualifying tests.

3.2.2.4 Independent Tests

The Government may at any time make visual inspections, continuity or resistance checks, insulation resistance readings, power factor tests, or dc high-potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with acceptable values for the application, will be grounds for rejection of the cable.

3.2.2.5 Reports

Furnish results of tests made. No wire or cable shall be shipped until authorized. Lot number and reel or coil number of wire and cable tested shall be indicated on the test reports.

WIRE TABLE

Item No.	Size, AWG or kcmil	No. of Conds.	Rated Circuit Voltage	Stranding	Comments	Quantity lin ft.
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

Class ___ stranding may be substituted for ___ where indicated by "*".

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SECTION 26 05 48.00 10

SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

This section covers seismic protection of electrical equipment, conduit, and exterior utilities.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	Steel Construction Manual

ASTM INTERNATIONAL (ASTM)

ASTM E 580/E 580M	Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL 1598	Luminaries

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the electrical equipment and systems listed below. Structural requirements shall be in accordance with Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

1.3.2 Electrical Equipment

Electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

Control Panels	Air Handling Units

Pumps with Motors	Switchgear
Light Fixtures	Unit Substations
Motor Control Centers	Transformers
Switchboards (Floor Mounted)	Storage Racks

1.3.3 Electrical Systems

The following electrical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification.

1.3.4 Contractor Designed Bracing

Design the bracing in accordance with UFC 3-310-04 and additional data furnished by the COR. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. UFC 3-310-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using UFC 3-310-04 are based on strength design; therefore, AISC 325 shall be used for the design. The bracing for the following electrical equipment and systems shall be developed by the Contractor.

1.3.5 Conduits Requiring No Special Seismic Restraints

Seismic restraints may be omitted from electrical conduit less than 2-1/2 inches trade size. All other interior conduit, shall be seismically protected as specified.

1.4 EQUIPMENT REQUIREMENTS

1.4.1 Rigidly Mounted Equipment

The following specific items of equipment to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in UFC 3-310-04. Each item of rigid electrical equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

Engine-Generators
Substations
Transformers
Switch Boards and Switch Gears
Motor Control Centers
Free Standing Electric Motors

1.4.2 Nonrigid or Flexibly-Mounted Equipment

The following specific items of equipment to be furnished shall be constructed and assembled to resist a horizontal lateral force times the operating weight of the equipment at the vertical center of gravity of the equipment.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in

accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting Fixtures in Buildings
Equipment Requirements

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Lighting Fixtures in Buildings
Equipment Requirements

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a California registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Contractor Designed Bracing

Copies of the Design Calculations with the Drawings. Calculations shall be approved, certified, stamped and signed by a Registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

PART 2 PRODUCTS

2.1 LIGHTING FIXTURE SUPPORTS

Lighting fixtures and supports shall conform to UL 1598.

2.2 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe in accordance with Section 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

3.2 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the following:

3.2.1 Pendant Fixtures

Pendant fixtures shall conform to the requirements of UFC 3-310-04.

3.2.2 Ceiling Attached Fixtures

3.2.2.1 Recessed Fluorescent Fixtures

Recessed fluorescent individual or continuous-row mounted fixtures shall be supported by a seismic-resistant suspended ceiling support system built in accordance with ASTM E 580/E 580M and Section 09 51 00 ACOUSTICAL CEILINGS. Seismic protection for the fixtures shall conform to the requirements of UFC 3-310-04. Recessed lighting fixtures not over 56 pounds in weight may be supported by and attached directly to the ceiling system runners using screws or bolts, number and size as required by the seismic design. Fixture accessories, including louvers, diffusers, and lenses shall have lock or screw attachments.

3.2.2.2 Surface-Mounted Fluorescent Fixtures

Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system built in accordance with ASTM E 580/E 580M andSection 09 51 00 ACOUSTICAL CEILINGS. Seismic protection for the fixtures shall conform to the requirements of UFC 3-310-04.

3.2.3 Assembly Mounted on Outlet Box

A supporting assembly, that is intended to be mounted on an outlet box, shall be designed to accommodate mounting features on 4 inch boxes, plaster rings, and fixture studs.

3.2.4 Wall-Mounted Emergency Light Unit

Attachments for wall-mounted emergency light units shall be designed and secured for the worst expected seismic disturbance at the site.

3.2.5 Lateral Force

Structural requirements for light fixture bracing shall be in accordance with Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

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SECTION 26 05 71.00 40

LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SUMMARY

This section covers circuit breakers, fuses, motor controls, and control devices.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C39.1	Requirements for Electrical Analog Indicating Instruments

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M	Standard Specification for Gray Iron Castings
ASTM D 877	Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 443	NARM Standard for Solid State Relays Service

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.17	Standard for Trip Devices for AC and General-Purpose DC Low-Voltage Power Circuit Breakers
IEEE C37.90	Standard for Relays and Relay Systems Associated With Electric Power Apparatus
IEEE C57.13	Standard Requirements for Instrument Transformers
IEEE C63.2	Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to

	40 GHz - Specifications
IEEE C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

IPC - ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)

IPC D330	Design Guide Manual

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	Electric Meters Code for Electricity Metering
ANSI C78.23	American National Standard for Incandescent Lamps - Miscellaneous Types
NEMA 107	Methods of Measurement of Radio Influence Voltage (RIV) of High-Voltage Apparatus (inactive)
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 3	Molded Case Circuit Breakers and Their Application
NEMA FU 1	Low Voltage Cartridge Fuses
NEMA ICS 1	Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	Enclosures

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 20	General-Use Snap Switches
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 508	Industrial Control Equipment

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Prior to the beginning of construction, submit manufactures equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.

Fuses

SD-02 Shop Drawings

Submit Connection Diagrams and Fabrication Drawings for the following items in accordance with paragraph entitled, "General Requirements," of this section.

Submit Installation drawings for the following items in accordance with the paragraph entitled, "Installation," of this section.

Control Devices
Protective Devices

SD-03 Product Data

Submit manufacturer's equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.

Motor Control
Instrument Transformers
Enclosures
Circuit Breakers
Control Devices
Time Switches
Protective Relays
Indicating Instruments
Indicating Lights

SD-07 Certificates

Submit certificates for Circuit Tests on similar motor-control or submit motor-circuit protector (MCP) units under actual conditions in lieu of factory tests on the actual units provided. Also include dielectric tests.

SD-08 Manufacturer's Instructions

Submit manufacturer's instructions for the following items, including special provisions required to install equipment components and system packages. Provide detail on resistance impedances, hazards and safety precautions within the special notices.

Control Devices
Protective Devices

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for the following equipment:

Manual Motor Controllers

Magnetic Motor Controllers
Combination Motor Controllers
Circuit Breakers
Time Switches
Protective Relays
Indicating Instruments

1.4 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Connection Diagrams showing the relations and connections of control devices and protective devices by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit Fabrication Drawings for control devices and protective devices consisting of fabrication and assembly details to be performed in the factory.

PART 2 PRODUCTS

2.1 MOTOR CONTROL

Conform to NEMA ICS 1, NEMA ICS 2, and UL 508 for motor controllers. Provide controllers that have thermal overload protection in each phase.

2.1.1 Manual Motor Controllers

Provide full-voltage, manually operated manual motor controllers for the control and protection of single-phase 60-hertz ac fractional-horsepower squirrel-cage induction motors.

Provide single-throw, single- or double-pole, three-position controllers rated at not more than 1 horsepower at 115- and 230-volts single phase. Include a supporting base or body of electrical insulating material with enclosed switching mechanism, yoke, thermal overload relay, and terminal connectors. Provide controllers that clearly indicate operating condition: on, off, or tripped.

Provide toggle- or key-operated type manual motor controllers as indicated and arrange so that they are lockable with a padlock in the "OFF" position.

Provide recessed manual motor controllers for single-speed, fractional-horsepower squirrel-cage induction motors, that include a single controller and indicating light in a 4-inch square wall outlet box, for flush-wiring devices with matching corrosion-resistant steel flush cover plate. Provide surface-mounted manual motor controllers for single-speed, fractional-horsepower squirrel cage induction motors that include a single controller and indicating light in a NEMA 250, Type 1 general-purpose enclosure.

Provide recessed and surface-mounted manual motor controllers for two-speed, fractional-horsepower squirrel-cage induction motors, that include two controllers, two indicating lights, and a selector switch in a multiple-gang wall outlet box for flush-wiring devices, with matching corrosion-resistant steel flush-cover plate. Provide surface-mounted manual motor controllers for two-speed fractional-horsepower squirrel-cage

induction motors, that include two controllers, two indicating lights, and a selector switch in a NEMA 250, Type 1 general-purpose enclosure.

2.1.2 Magnetic Motor Controllers

2.1.2.1 Full-Voltage Controllers

Provide full-voltage, full magnetic devices in accordance with NEMA ICS 1, NEMA ICS 2, and UL 508for magnetic motor controllers for the control and protection of single- and three-phase, 60-hertz, squirrel-cage induction motors.

Provide operating coil assembly that operates satisfactorily between 85 and 110 percent of rated coil voltage. Provide 120 volts, 60 hertz motor control circuits.

Provide controller with two normally open and two normally closed auxiliary contacts rated per NEMA ICS 1 and NEMA ICS 2 in addition to the sealing-in contact for control circuits.

Provide solderless pressure wire terminal connectors for line-and load-connections to controllers.

Include three manual reset thermal overload devices for overcurrent protection, one in each pole of the controller. Provide thermal overload relays of melting-alloy or bimetallic nonadjustable type with continuous current ratings and service-limit current ratings, and with a plus or minus 15 percent adjustment to compensate for ambient operating conditions.

Provide an externally operable manual-reset button to re-establish control power to the holding coil of the electromagnet. After the controller has tripped from overload, ensure that resetting the motor-overload device does not restart the motor.

Provide enclosure in accordance with NEMA 250, Type 4.

2.1.2.2 Reduced-Voltage Starters

Conform to the requirements for full-voltage controllers for reduced-voltage starters, except for voltage, and to the following additional requirements.

Fully protect the motor during all phases of motor starting with an overload device in each motor leg. Rate starter contacts to withstand the switching surges during selector to full voltage. Provide starter that contains the necessary sensing and timing devices to monitor motor operation and select the correct time for selector to full voltage.

Adequately ventilate resistors and autotransformers used for starting. Ventilate solid-state starters for starting cycles as well as any follow-on restart-run cycles. Operate external control circuits or solid-state starters at a maximum of 120 volts ac.

For solid-state starters, provide adjustable starting torque from 0 to 50 percent of applied voltage, minimum. Provide autotransformer starters with a minimum of three taps above 50 percent reduced voltage.

2.1.3 Combination Motor Controllers

Following requirements are in addition to the requirements specified for magnetic motor controller:

Provide combination motor controllers for the control and protection of single-and three-phase 60-hertz alternating-current squirrel-cage induction motors with branch-circuit disconnecting and protective devices in accordance with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

For combination motor controllers include magnetic motor controllers and molded-case circuit breakers or MCP in metal enclosures in accordance with NEMA 250 or motor-control center draw-out assemblies with control-power transformers, selector switches, pushbuttons, and indicating lights as follows:

Provide full-voltage, full-magnetic devices as specified in this section under paragraph entitled, "Remote-Control Station Enclosures." for magnetic motor controllers and enclosures.

Provide thermal-magnetic breakers as specified in paragraph entitled, "Manual Motor Controllers."for molded-case circuit breakers. Manufacturer's standard MCP may be used in lieu of molded-case circuit breakers.

Provide control-power transformers 120-volt ac maximum, selector switches, pushbuttons, and pilot lights as required.

Identify combination motor controllers with identification plates affixed to front cover of the controller.

2.1.3.1 Nonreversing Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For nonreversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors, include a magnetic controller with molded-case circuit breaker or MCP with selector switch or start/stop pushbutton and indicating light in the cover of the enclosure.

Provide rating of single and three-phase single-speed full-voltage magnetic controllers for nonplugging and nonjogging duty in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide wiring and connections for full-voltage single-speed magnetic controllers in accordance with NEMA ICS 1 and NEMA ICS 2.

2.1.3.2 Reversing Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For reversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors, include two interlocked magnetic controllers with molded-case circuit breaker or MCP, with selector switch or forward/reverse/stop pushbutton and two indicating lights in the cover of the enclosure. Indicate with indicating lights the forward and

reverse running connection of the motor controller.

Provide rating of single and three-phase single-speed full-voltage magnetic controllers for plug-stop, plug-reverse, or jogging duty in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide wiring and connections for full-voltage single-speed magnetic controllers in accordance with NEMA ICS 1 and NEMA ICS 2.

2.1.3.3 Two-Speed Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For two-speed combination motor controllers for the control and protection of single- and two-winding, two-speed, three-phase, squirrel-cage induction motors, include two magnetic controllers with molded-case circuit breaker or MCP, with selector switch or fast/slow/stop pushbutton and two indicating lights in the cover of the enclosure. Indicate with indicating lights the high- and low-speed running connection of the motor controller.

Provide rating of three-phase, two-speed, full-voltage, magnetic controllers for nonplugging and nonjogging duty for constant- and variable-torque motors in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide rating of three-phase, two-speed, full-voltage, magnetic controllers for nonplugging and nonjogging duty for constant-horsepower motors in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide rating of three-phase, two-speed, full-voltage, magnetic controllers for plug-stop, plug-reverse, or jogging duty for constant-torque, variable-torque, and constant horsepower motors in accordance with NEMA ICS 1 and NEMA ICS 2.

2.2 INSTRUMENT TRANSFORMERS

Comply with the interference requirements listed below, measured in accordance with IEEE C63.2, IEEE C63.4, and NEMA 107 for Instrument transformers.

Insulation Class, kV	Basic Insulation Level, kV	Preferred Nominal System Voltage, kV	Test Voltage for Potential Transformers, kV	Test Voltage for Current Transformers, kV	Radio Influence Voltage Level, Microvolts Dry Type	Radio Influence Voltage Level, Microvolts Oil Filled
0.6	10	.....	.....	0.76	250	250
1.2	30	0.208 0.416 0.832 1.04	0.132 0.264 0.528 0.66	0.76	250	250
2.5	45	2.40	1.52	1.67	250	250
5.0	60	4.16 4.80	2.64 3.04	3.34	250	250

Insulation Class, kV	Basic Insulation Level, kV	Preferred Nominal System Voltage, kV	Test Voltage for Potential Transformers, kV	Test Voltage for Current Transformers, kV	Radio Influence Voltage Level, Microvolts Dry Type	Radio Influence Voltage Level, Microvolts Oil Filled
8.7	75	7.20 8.32	4.57 5.28	5.77	250	250
15L or 15H	95-110	12.00 12.47 14.40	7.62 7.92 9.14	9.41	1000	250
25	150	23.00	14.60	15.70	2500	650
34.5	200	34.50	21.90	23.0	....	650
46	250	46.00	29.20	29.30	....	1250
69	350	69.00	43.80	44.00	....	1250
92	450	92.00	58.40	58.40	....	2500
115	550	115.00	73.40	73.40	....	2500
138	650	138.00	88.00	88.00	....	2500

2.2.1 Current Transformers

Provide current transformers that conform to IEEE C57.13 for installation in metal-clad switchgear. Use standard 3-A secondary transformer.

Provide wound type transformers.

Provide transformers that have single secondary winding.

Provide transformers that are complete with secondary short-circuiting device.

For window-type current transformers, provide indoor dry type construction with secondary current ratings as indicated with specified burden, frequency, and accuracy.

2.2.2 Potential Transformers

For potential transformers, conform to IEEE C57.13 for installation in metal-clad switchgear. Use standard 120-volt secondary transformers.

Provide transformers that have single secondary.

Provide burden, frequency, and accuracy as required.

For disconnecting potential transformers with integral fuse mountings and current-limiting fuses, provide indoor dry type two-winding construction with primary and secondary voltage ratings as required.

2.3 ENCLOSURES

2.3.1 Equipment Enclosures

Provide enclosures for equipment in accordance with NEMA 250.

Contain equipment installed inside, clean, dry locations in a NEMA Type 1, general-purpose sheet-steel enclosure.

Contain equipment installed in wet locations in a NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosure, constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 for Type 4 enclosures.

Contain equipment installed in industrial locations in a NEMA Type 12 industrial use, sheet-steel enclosure, constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

Provide cast-iron enclosures from gray-iron castings conforming to ASTM A48/A48M with tensile-strength classification recognized as suitable for the application. Provide cast metal enclosures that are not less than 1/8-inch thick at every point, of greater thickness at reinforcing ribs and door edges, and not less than 1/4-inch thick at tapped holes for conduits.

2.3.2 Remote-Control Station Enclosures

Provide remote-control station enclosures for pushbuttons, selector switches, and indicating lights in accordance with the appropriate articles of NEMA ICS 6 and NEMA 250.

Contain remote-control stations installed in indoor, clean, dry locations in NEMA Type 1 general-purpose, sheet-steel enclosures. Contain recessed remote-control stations in standard wall outlet boxes with matching corrosion-resistant steel flush cover plate.

Contain remote-control stations installed in wet locations in NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosures constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 and NEMA 250 for Type 4 enclosures.

Contain remote-control stations installed in wet locations in NEMA Type 4 watertight, cast-iron enclosures, constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 and NEMA 250 for Type 4 enclosures.

Install remote-control stations with the centerline 66 inches above the finished floor.

2.4 CIRCUIT BREAKERS

Provide circuit breakers that conform to UL 489, and NEMA AB 3.

2.4.1 Molded-Case Circuit Breakers

Provide molded case, manually operated, trip-free, circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection as required. Completely enclose circuit breakers in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.

Locate thermal-magnetic tripping elements in each pole of the circuit breaker, and provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. Provide instantaneous magnetic tripping element, that is adjustable and accessible from the front of the breaker on frame sizes larger than 100 amperes.

Size breaker as required for the continuous current rating of the circuit. Provide breaker class as required.

Provide sufficient interrupting capacity of the panel and lighting branch circuit breakers, to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Provide circuit breaker interrupting capacities with a minimum of 10,000 amperes and that conform to NEMA AB 3.

Provide the common-trip type multipole circuit breakers having a single operating handle and a two-position on/off indication. Provide circuit breakers with temperature compensation for operation in an ambient temperature of 104 degrees F. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).

Provide phenolic composition breaker body capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

Provide circuit breakers used for meter circuit disconnects that meet the applicable requirements of CEC and that are of the motor-circuit protector type.

For circuit breakers used for service disconnection, provide an enclosed circuit-breaker type with external handle for manual operation. Provide sheet metal enclosures with a hinged cover suitable for surface mounting.

2.4.2 Enclosed Molded-Case Circuit Breakers

For enclosed circuit breakers, provide thermal-magnetic molded-case circuit breakers in surface-mounted, nonventilated enclosures conforming to the appropriate articles of NEMA 250 and UL 489.

Provide enclosed circuit breakers in nonhazardous locations as follows:

Contain circuit breakers installed inside clean, dry locations in NEMA Type 1, general purpose sheet steel enclosures.

Contain circuit breakers installed in unprotected outdoor locations, in NEMA Type 3R, weather-resistant sheet steel enclosures that are splashproof, weatherproof, sleetproof, and moisture resistant.

Contain circuit breakers installed in wet locations, in NEMA Type 4, watertight corrosion-resistant sheet steel enclosures constructed to prevent entrance of water.

Contain circuit breakers installed in wet locations in NEMA Type 4, watertight cast-iron enclosures, constructed to prevent entrance of water when tested in accordance with NEMA ICS 1 for Type 4 enclosures.

2.5 FUSES

Provide a complete set of fuses for all switches and switchgear. Rate fuses that have a voltage rating of not less than the circuit voltage.

Make no change in continuous-current rating, interrupting rating, and clearing or melting time of fuses unless written permission has first been secured.

Provide nonrenewable cartridge type fuses for ratings 30 amperes, 125 volts or less. Provide renewable cartridge type fuses for ratings above 30 amperes 600 volts or less with time-delay dual elements, except where otherwise indicated. Conform to NEMA FU 1 for fuses.

Install special fuses such as extra-high interrupting-capacity fuses, fuses for welding machines, and capacitor fuses where required. Plug fuses are not permitted.

Label fuses showing UL class, interrupting rating, and time-delay characteristics, when applicable. Additionally, clearly list fuse information on equipment drawings.

Provide porcelain fuse holders when field-mounted in a cabinet or box. Do not use fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber for field installation.

2.6 CONTROL DEVICES

2.6.1 Magnetic Contactors

Provide magnetic contactors in accordance with NEMA ICS 1 and NEMA ICS 2 as required for the control of low-voltage, 60-hertz, tungsten-lamp loads, fluorescent-lamp loads, resistance-heating loads, and the primary windings of low-voltage transformers.

Provide core-and-coil assembly that operates satisfactorily with coil voltage between 85 and 110 percent of its voltage rating.

Provide contactor that is designed with a normally open holding circuit auxiliary contact for control circuits, with a rating in accordance with NEMA ICS 1 and NEMA ICS 2.

Furnish solderless pressure wire terminal connectors, or make available for line-and-load connections to contactors in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide magnetic contactors with a rating in accordance with NEMA ICS 1and NEMA ICS 2.

2.6.2 Control-Circuit Transformers

Provide control-circuit transformers within the enclosure of magnetic contactors and motor controllers when the line voltage is in excess of 120 volts. Provide encapsulated dry type, single-phase, 60-hertz transformer, with a 120-volt (or 24-volt) isolated secondary winding.

Do not provide a transformer with a rated primary voltage less than the rated voltage of the controller, or a rated secondary current less than the continuous-duty current of the control circuit.

Provide voltage regulation of the transformer such that, with rated primary voltage and frequency, the secondary voltage is not less than 95 percent nor more than 105 percent of rated secondary voltage.

Provide source of supply for control-circuit transformers at the load side of the main disconnecting device. Protect secondary winding of the transformer and control-circuit wiring against overloads and short circuits, with fuses selected in accordance with NEMA ICS 6. Ground secondary winding of the control-circuit transformer in accordance with NEMA ICS 6.

2.6.3 Magnetic Control Relays

Provide magnetic control relays for energizing and de-energizing the coils of magnetic contactors or other magnetically operated devices, in response to variations in the conditions of electric control devices in accordance with NEMA ICS 1, and NEMA ICS 2.

Provide core-and-coil assembly that operates satisfactorily with coil voltages between 85 and 110 percent of their voltage rating.

Provide relays that are designed to accommodate normally open and normally closed contacts.

Provide 120-volt, 60-hertz, Class AIB magnetic control relays with a continuous contact rating of 10 amperes, and with current-making and -breaking ability in accordance with NEMA ICS 1 and NEMA ICS 2, two normally open and two normally closed.

2.6.4 Pushbuttons and Switches

2.6.4.1 Pushbuttons

For pushbuttons for low-voltage ac full-voltage magnetic controllers, provide heavy-duty oiltight NEMA 250, Type 12, momentary-contact devices rated 600 volts, with pilot light, and with the number of buttons and the marking of identification plates as shown. Furnish pushbutton color code in accordance with NEMA ICS 6.

Provide pushbuttons that are designed with normally open, circuit-closing contacts; normally closed circuit-opening contacts; and two-circuit normally open and normally closed circuit-closing and -opening contacts. Provide pushbutton-contact ratings in accordance with NEMA ICS 1 and NEMA ICS 2 with contact designation A600.

Identify pushbuttons in remote control stations with identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

2.6.4.2 Selector Switches

Provide heavy-duty oiltight maintained-contact selector switches for low-voltage control circuits, with the number of positions and the marking of identification plates in accordance with NEMA ICS 1 and NEMA ICS 2.

Identify selector switches in remote control stations with engraved identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the

identification plate.

2.6.4.3 Ammeter Selector Switches

Provide rotary multistage snap-action type ammeter selector switches for switchgear in accordance with UL 20 with silver-plated contacts rated for 600 volts ac or dc. Provide a manually operated, four-position selector switch rated for 600 volts, 20 amperes, minimum, and designed to permit current readings on each bus of the main bus from a single indicating instrument. Mount ammeter switch on the hinged front panel of the switchgear compartment and completely isolate it from high-voltage circuits, with engraved escutcheon plate.

Provide a oval type selector switch handle.

2.6.4.4 Voltmeter Selector Switches

Provide rotary snap-action type voltmeter selector switches for switchgear in accordance with UL 20 with silver-plated contacts rated for 600 volts ac or dc. Provide manually operated, four-position switch designed to permit voltage readings on each phase of the main bus from a single indicating instrument. Mount voltmeter switch on the hinged front panel of the switchgear compartment and completely isolate from high-voltage circuits, and with engraved escutcheon plate.

Provide a oval type selector switch handle.

2.6.4.5 Miscellaneous Switches

Provide float, limit, door, pressure, proximity, and other types of switches in accordance with IPC D330 and of the types and classes indicated.

2.7 TIME SWITCHES

Provide time switches for the control of tungsten-lamp loads, fluorescent-lamp loads, resistive-heating loads, motors, and magnetically operated devices, consisting of a motor-driven time dial and switch assembly in a NEMA 250, Type 1 general-purpose enclosure.

Provide motor drives consisting of 120-volt, single-phase, 60-hertz, heavy-duty, self-starting synchronous motors, directly connected to the time dial through a geartrain operating mechanism. Provide a spring-wound stored-energy source of reserve power that will automatically operate the mechanism for a period of not less than 12 hours in case of electric power failure. Provide spring that automatically rewinds electrically in not more than 3 hours of time after electric power is restored.

Include a heavy-duty general-purpose precision snap-action switch in accordance with UL 20 for switch mechanism, with provision for a manual "OFF" and "ON" operation of the switch.

Provide 7-day type time dials with adjustable on and off trippers for programmed switching operations for each day in the week. Provide dial that makes one revolution in the 7-day period of time not more than 2 1/2 hours, and is fully adjustable upward in 2-hour intervals of time throughout each day. Calibrate dial in 2-hour intervals for each day and for each day in the week around its circumference.

Provide astronomic type time dials which automatically change settings

each day, in accordance with the seasonal time changes in sunrise and sunset. Provide astronomic type dials that have adjustable on and off trippers, for repetitive switching operations at solar time each day and each day in the year and that make one revolution in a 24-hour period of time. Provide time dials that are designed to operate in the "ON" position at sunset and be fully adjustable upward in 15-minute intervals of time throughout each day, and that indicate the day and month of the year. Calibrate dial in 15-minute intervals over a 24-hour period of time around its circumference. Make provision to defeat the switching operation over weekends or up to 6 preselected calendar days each week.

2.8 PROTECTIVE RELAYS

2.8.1 Overcurrent Relays

Conform to IEEE C37.90 for overcurrent relays.

For protection against phase and ground faults, provide digital relays as indicated on the drawings.

Provide solid-state static-type trips for low-voltage power circuit breakers in accordance with EIA 443 and IEEE C37.17.

Provide a trip unit that employs a combination of discreet components and integrated circuits to provide the time-current protection functions required in a modern selectively coordinated distribution system. Provide switchable or easily defeatable instantaneous and ground fault trips.

Make all adjustments using non-removable, discrete step, highly reliable switching plugs for precise settings. Provide a sealable, transparent cover over the adjustments to prevent tampering.

Furnish trip devices with three visual indicators to denote the automatic tripping mode of the breaker including: overload; short circuit; and ground fault.

Wire trip unit to appropriate terminals whereby an optional remote automatic trip accessory can be utilized to provide the same indication.

Make available for use a series of optional automatic trip relays for use with the trip unit to provide remote alarm and lockout circuits.

Provide all trip units with test jacks for in-service functional testing of the long-time instantaneous and ground fault circuits using a small hand-held test kit.

2.8.2 Directional Overcurrent Relays

Provide directional overcurrent relays in accordance with IEEE C37.90.

For directional overcurrent relays for protection against reverse-power faults, provide single-phase induction type with adjustable time-delay and instantaneous trip attachments. Provide removable type relays with inverse-time directional and overcurrent units with built-in testing facilities.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.8.3 Reclosing Relays

For reclosing relays, conform to IEEE C37.90.

Design reclosing relays to reclose circuit breakers that have tripped from overcurrent. Provide device that automatically recloses the breaker at adjustable time intervals between reclosures and then locks out the breaker in the open position if the fault persists. If the fault disappears after any reclosure, the circuit breaker remains closed and the reclosing relay resets automatically and is ready to start a new sequence of operation.

Provide removable reclosing relays with built-in testing facilities and consisting of a timing unit rated at 120/240 volts, single-phase, ac and solenoid and contactor units with dc rating as indicated. Arrange contacts for one instantaneous reclosure and two subsequent reclosures at 15 and 45 seconds, respectively. Set time dial for 60-second drum speed.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.8.4 Undervoltage Relays

For undervoltage relays conform to IEEE C37.90.

Provide three-phase induction type undervoltage relays, including inverse timing with adjustable high- and low-voltage contacts and calibrated scale for protection against loss of voltage, undervoltage, and overvoltage. Equip relays with indicating contactor and voltage switches to provide electrically separate contact circuits. Provide relays that are removable with built-in testing facilities and that are suitable for operation on 120-volt ac circuits, with contacts that are suitable for operation on dc or ac control circuits.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.9 INDICATING INSTRUMENTS

2.9.1 Ammeters

For ammeters, conform to ANSI C39.1.

Provide switchboard indicating ammeters of approximately 4-1/2 inches square with 250-degree scale and recessed cases suitable for flush mounting. Furnish white dials with black figures and black pointers. Mount instruments on the hinged front panel of the switchgear compartment completely isolated from high-voltage circuits. Provide standard 5-ampere type meter for a zero to full-scale normal movement, 60 hertz.

2.9.2 Voltmeters

For voltmeters, conform to ANSI C39.1.

Provide a switchboard indicating voltmeters that is approximately 4-1/2-inches square with 250-degree scale and recessed cases suitable for flush mounting. Furnish white dials with black figures and black pointers. Mount instruments on the hinged front panel of the switchgear compartment completely isolated from high-voltage circuits. Provide standard 120-volt type voltmeter for a zero to full-scale normal movement, 60 hertz.

2.9.3 Watt-Hour Meters/Wattmeters

For watt-hour meters, wattmeters, and pulse initiation meters, conform to ANSI C12.1.

Provide three-phase induction type switchboard wattmeters for use with instrument transformers with two stators, each equipped with a current and potential coil. Provide meter that is rated for 5 amperes at 120 volts and is suitable for connection to three-phase, 3- and 4-wire circuits. Provide instrument complete with potential indicating lamps, light-load and full-load adjustments, phase balance, power-factor adjustments, four-dial clock register, ratchets to prevent reverse rotation, and built-in testing facilities.

Provide pulse initiating meters for use with demand meters or pulse recorders, that are suitable for use with mechanical or electrical pulse initiators. Provide mechanical load imposed on the meter by the pulse initiator that is within the limits of the pulse meter. Provide load as constant as practical throughout the entire cycle of operation to ensure accurate meter readings. Provide pulse initiating meter that is capable of measuring the maximum number of pulses at which the pulse device is nominally rated. Consider pulse initiating meter to be operating properly when a kilowatt hour check indicates that the demand meter kilowatthours are within limits of the watthour meter kilowatthours.

Locate pulse initiating meters such that components sensitive to moisture and temperature conditions are minimized. Take precautions to protect sensitive electronic metering circuitry from electromagnetic and electrostatic induction.

Furnish removable meters with draw out test plug and furnish contact devices to operate remote impulse-totalizing graphic demand meters.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.9.4 Graphic Demand Meters

For impulse-totalizing graphic demand meters, conform to ANSI C12.1.

Provide impulse-totalizing graphic demand meters that are suitable for use with switchboard watt-hour meters and that include a two-circuit totalizing relay, cyclometer for cumulative record of impulses, four-dial totalizing kilowatt-hour register, synchronous motor for timing mechanism, torque motor, and chart drive. Provide a positive chart-drive mechanism consisting of chart spindles and drive sprockets that maintains the correct chart speed for roll strip charts. Provide instrument that records as well as indicates on clearly legible graph paper, the 15-minute integrated kilowatt demand of the totalized system.

Furnish the motive power for advancing the register and pen-movement mechanism with a torque motor. Provide capillary pen containing a 1-month ink supply. Provide a 31-day continuous record of operation roll charts.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.9.5 Specialty-Type Meters

For specialty meters, conform to ANSI C39.1. Specialty-type meters are panel meters applicable to specific situations, such as pyrometers and dc

parameter meters that conform to the panel layout specified. Provide meter scales that are not less than 180 degrees. Do not use edgewise meters for circuit current and voltage measurements.

2.10 FACTORY TESTING

Perform factory tests on control and low voltage protective devices in accordance with the manufacturer's recommendations.

Conduct short-circuit tests in accordance with Section 2 of NEMA ICS 1.

2.11 INDICATING LIGHTS

2.11.1 General-Purpose Type

For indicating lights, provide oiltight instrument devices with threaded base and collar for flush-mounting, translucent convex lens, candelabra screw-base lampholder, and 120-volt, 6-watt, Type S-6 incandescent lamp in accordance with ANSI C78.23. Provide indicating lights color coded in accordance with NEMA ICS 6.

Provide indicating lights in remote-control stations when pushbuttons and selector switches are out of sight of the controller.

2.11.2 Switchboard Indicating Lights

For switchboard indicating lights, provide the manufacturer's standard transformer type units 120-volt input utilizing low-voltage lamps and convex lenses of the colors indicated. Provide indicating lights that are capable of being relamped from the switchboard front. Indicating lights utilizing resistors in series with the lamps are not permitted except in direct-current control circuits. Provide lights that have a press-to-test feature.

2.12 FINISH

Protect metallic materials against corrosion. Provide equipment with the standard finish by the manufacturer when used for most indoor installations.

PART 3 EXECUTION

3.1 INSTALLATION

Install Control devices and protective devices that are not factory installed in equipment, in accordance with the manufacturer's recommendations and field adjusted and operation tested. Conform to CEC, NEMA ICS 1 and NEMA ICS 2 requirements for installation of control and protective devices.

3.2 FIELD TESTING

Demonstrate to operate as indicated control and protective devices not factory installed in equipment.

Ratio and verify tap settings of instrumentation, potential, and current transformers.

Perform dielectric tests on insulating oil in oil circuit breakers before the breakers are energized. Test oil in accordance with ASTM D 877, and

provide breakdown voltage that is not less than 25,000 volts. Provide manufacturer certification that the oil contains no PCB's, and affix a label to that effect on each breaker tank and on each oil drum containing the insulating oil.

Field adjust reduced-voltage starting devices to obtain optimum operating conditions. Provide test meters and instrument transformers that conform to ANSI C12.1 and IEEE C57.13.

Do not energize control and protective devices until recorded test data has been approved. Provide final test reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

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SECTION 26 08 00

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SECTION 26 08 00

APPARATUS INSPECTION AND TESTING

PART 1 GENERAL

1.1 SUMMARY

This section covers electrical inspection and testing.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

1.3 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Acceptance tests and inspections

SD-07 Certificates

Qualifications of organization, and lead engineering technician

Acceptance test and inspections procedure

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be

independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.

b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.5.2 Acceptance Tests and Inspections Reports

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

1.5.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. COR shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

a. Section 26 12 19.00 40 PAD-MOUNTED LIQUID FILLED MEDIUM VOLTAGE TRANSFORMERS

b. Section 26 23 00.00 40 SWITCHBOARDS

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

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SECTION 26 09 23.00 40

LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SUMMARY

This section covers photoconductive-lighting control devices for use with exterior lighting systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C136.10	American National Standard for Roadway and Area Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles--Physical and Electrical Interchangeability and Testing
NEMA ICS 6	Enclosures

UNDERWRITERS LABORATORIES (UL)

UL 773	Standard for Plug-In, Locking Type Photocontrols for Use with Area Lighting
UL 773A	Standard for Nonindustrial Photoelectric Switches for Lighting Control
UL 98	Enclosed and Dead-Front Switches

1.3 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Installation Drawings for light-sensitive control devices in accordance with the manufacturer's recommended instructions for installation.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit manufacturer's catalog data for Photoconductive Control Devices.

Submit Installation Drawings for Light-Sensitive Control Devices in accordance with paragraph entitled, "General Requirements," of this section.

Lighting Contactor

Photocell Switch

SD-06 Test Reports

Submit test reports for System Operation Tests in the presence of the COR.

SD-08 Manufacturer's Instructions

Submit operational instructions for Light-Sensitive Control Devices consisting of the manufacturer's recommended procedures for operation.

SD-10 Operation and Maintenance Data

Lighting Control System, Data Package 5

1.5 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

PART 2 PRODUCTS

2.1 MANUAL AND SAFETY SWITCHES

Provide Astronomic dial type arranged to turn "ON" at sunset, and turn "OFF" at a pre-determined time between 2030 hours hours and 0230 hours or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide a switch rated 277 volts, having automatically wound spring mechanism battery backed electronic clock to maintain accurate time for a minimum of 7 hours following a power

failure, with a time switch with a manual on-off bypass switch. Provide surface mounted housing for the time switch, type NEMA 3R 4 (outdoor) enclosure conforming to NEMA ICS 6.

Provide switches conforming to UL 98. Provide switch construction of the quick-make, quick-break type, such that a screwdriver is required to open the switch door when the switch is on, with blades visible when the door is open. Coordinate terminal lugs with the wire size.

2.2 TIME SWITCH

Provide astronomic dial type or electronic type, arranged to turn "ON" at sunset and turn "OFF" at predetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide switch rated 277 volts, having automatically wound spring mechanism or capacitor, to maintain accurate time for a minimum of 7 hours following power failure. Provide time switch with a manual on-off bypass switch. Surface mount the housing for the time switch, NEMA 3R enclosure conforming to NEMA ICS 6.

2.3 PHOTOCELL SWITCH

Provide photocell switch conforming to UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated 277 volts ac, 60 Hz with single-throw contacts contacts for mechanically held contactors rated 1000 watts designed to fail to the ON position. Provide switch which turns on at or below 3 footcandles and off at 4 to 10 footcandles. Provide time delay to prevent accidental switching from transient light sources. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Provide switch:

a. Integral to the luminaire, rated 1000W minimum. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition.

b. In a U.V. stabilized polycarbonate housing with swivel arm and adjustable window slide, rated 1800 VA, minimum.

c. In a high-impact-resistant, noncorroding and nonconductive molded plastic housing with a locking-type receptacle conforming to ANSI C136.10, rated 1800 VA, minimum.

d. In a cast weatherproof aluminum housing with adjustable window slide, rated 1800 VA, minimum.

2.4 EQUIPMENT IDENTIFICATION

2.4.1 Manufacturer's Nameplate

Provide each item of equipment with a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in an inconspicuous place; the nameplate of the distributing agent is not acceptable.

2.4.2 Labels

Provide labeled control devices, clearly marked for operation of specific lighting functions according to type. Note the following devices characteristics in the format "Use Only":

Make markings related to control device type clear and locate to be readily visible to service personnel, but unseen from normal viewing angles when devices are in place.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Photoconductive Control Devices

Install photoconductive control devices in accordance with the manufacturer's installation instructions.

3.1.2 Time Control Switches

Install switches with not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

3.1.3 Manual and Safety Switches

Coordinate terminal lugs with the wire size. Securely fasten switches to the supporting structure or wall using not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

3.2 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Demonstrate that photoconductive control devices operate satisfactorily in the presence of the COR.

Perform System Operation Tests in accordance with referenced standards in this section.

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SECTION 26 12 19.00 40

PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SUMMARY

This section covers three-phase pad-mounted transformers of the dead-front and live-front types for exterior applications.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM C260/C260M	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM D 117	Standard Guide for Sampling, Test Methods, Specifications and Guide for Electrical Insulating Oils of Petroleum Origin
ASTM D 1535	Specifying Color by the Munsell System
ASTM D 3487	Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus
ASTM D 877	Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D 92	Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM D 97	Pour Point of Petroleum Products

FM GLOBAL (FM)

FM APP GUIDE	Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386	Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE C2	National Electrical Safety Code
IEEE C57.12.00	Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.28	Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.34	Standard for Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 5 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15 kV Nominal System Voltage and Below
IEEE C57.12.80	Standard Terminology for Power and Distribution Transformers
IEEE C57.12.90	Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.98	Guide for Transformer Impulse Tests
IEEE Stds Dictionary	IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

OECD Test 203	Fish Acute Toxicity Test

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-90/027F	Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms

EPA 712-C-98-075	Fate, Transport and Transformation Test Guidelines - OPPTS 835.3100- "Aerobic Aquatic Biodegradation"

UNDERWRITERS LABORATORIES (UL)

UL 467	Grounding and Bonding Equipment

1.3 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.4 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Stds Dictionary.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

a. A certification, from the manufacturer, that the technical requirements of this specification shall be met.

b. An outline drawing of the transformer with devices identified (paragraph entitled "Pad-Mounted Transformer Drawings", item a).

c. ANSI nameplate data of the transformer (paragraph entitled "Pad-Mounted Transformer Drawings", item b).

d. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses (paragraph entitled "Pad-Mounted Transformer Drawings", item e).

e. Routine and other tests (in PART 2, see paragraph entitled "Routine and Other Tests"), shall be conducted by the manufacturer and will be witnessed by the government (in Part 2, see paragraph entitled "Source Quality Control"). Provide transformer test schedule required by submittal item "SD-11 Closeout Submittals". Provide certified copies of the tests.

f. Provide acceptance test reports required by submittal item "SD-06 Test Reports".

g. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data".

SD-02 Shop Drawings

Pad-Mounted Transformer Drawings

SD-03 Product Data

Pad-Mounted Transformers

Submittal shall include manufacturer's information for each component, device, and accessory provided with the transformer.

SD-06 Test Reports

Acceptance Checks And Tests

SD-07 Certificates

Transformer Losses

Submit certification from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Losses."

SD-09 Manufacturer's Field Reports

Pad-mounted transformer Design Tests

Pad-mounted transformer Routine And Other Tests

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

SD-11 Closeout Submittals

Transformer Test Schedule

Submit report of test results as specified by paragraph entitled "Field Quality Control."

1.6 QUALITY ASSURANCE

1.6.1 Pad-Mounted Transformer Drawings

Drawings shall indicate, but not be limited to the following:

a. An outline drawing, with front, top, and side views.

b. ANSI nameplate data.

c. Elementary diagrams and wiring diagrams.

d. One-line diagram.

e. Manufacturer's published time-current curves (on full size logarithmic paper).

1.6.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the COR. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory

provisions of CEC unless more stringent requirements are specified or indicated.

1.6.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.3.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than 3 years prior to date of delivery to site, unless specified otherwise.

1.6.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.7 MAINTENANCE

1.7.1 Additions to Operation and Maintenance Data

In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

a. An instruction manual with pertinent items and information highlighted

b. An outline drawing, front, top, and side views

c. Prices for spare parts and supply list

d. Routine and field acceptance test reports

e. Actual nameplate diagram

f. Date of purchase

1.8 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified.

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.34, IEEE C57.12.28 and as specified herein.

2.2.1 Compartments

Separate the high- and low-voltage compartments with steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage, Dead-Front

High-voltage compartment shall contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, feed-thru inserts, six high-voltage bushing wells configured for loop feed application, tap changer handle, connector parking stands with insulated standoff bushings, protective caps, and ground pad.

a. Insulated high-voltage load-break connectors: IEEE 386, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

b. Bushing well inserts and feed-thru inserts: IEEE 386, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise.

c. Parking stands: Provide a parking stand near each bushing well. Provide insulated standoff bushings for parking of energized load-break connectors on parking stands.

d. Protective caps: IEEE 386, 200 amperes, 15 kV Class. Provide insulated protective caps (not shipping caps) for insulating and sealing out moisture from unused bushing well inserts and insulated standoff bushings.

2.2.1.2 Low Voltage

Low-voltage compartment shall contain low-voltage bushings with NEMA spade

terminals, accessories, current transformer, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

a. Accessories shall include drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.

b. Current Transformers: Provide window type current transformer 2000/5A, 10KV BIL, 600V, raiting factor 2.0 at 30oC. Mount current transformer on the pad mounted transformer secondary compartment. Provide glastic bracket to support current transformer.

2.2.2 Compartments Construction

Separate the high- and low-voltage compartments with steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.3 Transformer

a. Less-flammable liquid-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.

b. Transformer shall be rated 1500 kVA, 95 kV BIL.

c. Transformer voltage ratings: 13800 V - 480/277 V.

d. Tap changer shall be externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Tap changers shall clearly indicate which tap setting is in use.

e. Minimum tested impedance shall not be less than 5.75 percent at 85 degrees C on Three-Phase transformers.

f. Audible sound levels shall comply with the following:

kVA	DECIBELS (MAX)
75	51
112.5	55
150	55
225	55
300	55
500	56
750	57
1000	58
1500	60

g. Transformer shall include lifting lugs and provisions for jacking under base. The transformer base construction shall be suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. Transformer shall have its kVA rating conspicuously displayed on its enclosure. The transformer shall have an insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.

2.2.4 Insulating Liquid

a. Mineral oil: ASTM D 3487, Type II, tested in accordance with ASTM D 117. Provide identification of transformer as "non-PCB" and "Type II mineral oil" on the nameplate.

b. Less-flammable transformer liquids: CEC and FM APP GUIDE for less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D 92 and a dielectric strength not less than 33 kV tested per ASTM D 877. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

1. The fluid shall be a biodegradable electrical insulating and cooling liquid classified by UL and approved by FM as "less flammable" fluids. The fluid shall meet the following fluid properties:

(a) Pour point: ASTM D 97, less than -15 degree C

(b) Aquatic biodegradation: EPA 712-C-98-075, 100%

(c) Trout toxicity: OECD Test 203, zero mortality of EPA 600/4-90/027F, pass

2.2.4.1 Transformer Nameplates

Provide distribution transformers with nameplate information in accordance with IEEE C57.12.00 and as modified or supplemented by this section.

2.2.5 Corrosion Protection

Bases and cabinets of transformers shall be corrosion resistant and shall be fabricated of stainless steel conforming to ASTM A167, Type 304 or 304L. Base shall include any part of pad-mounted transformer that is within 3 inches of concrete pad. Paint bases, cabinets, and tanks Munsell 7GY3.29/1.5 green. Paint coating system shall comply with IEEE C57.12.28. The Munsell color notation is specified in ASTM D 1535.

2.3 WARNING SIGNS

Provide warning signs for the enclosures of pad-mounted transformers having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

2.4 GROUNDING AND BONDING

UL 467. Provide grounding and bonding.

2.5 PADLOCKS

Provide padlocks for pad-mounted equipment and for each fence gate. Padlocks shall be keyed as directed by the COR.

2.6 CAST-IN-PLACE CONCRETE

Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise. All concrete shall conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE for other projects.

Shall be composed of fine aggregate, coarse aggregate, portland cement, and water so proportioned and mixed as to produce a plastic, workable mixture. Fine aggregate shall be of hard, dense, durable, clean, and uncoated sand. The coarse aggregate shall be reasonably well graded from 3/16 inch to 1 inch. The fine and coarse aggregates shall be free from injurious amounts of dirt, vegetable matter, soft fragments or other deleterious substances. Water shall be fresh, clean, and free from salts, alkali, organic matter, and other impurities. Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise. Slump shall not exceed 4 inches. Retempering of concrete will not be permitted. Exposed, unformed concrete surfaces shall be given a smooth, wood float finish. Concrete shall be cured for a period of not less than 7 days, and concrete made with high early strength portland cement shall be repaired by patching honeycombed or otherwise defective areas with cement mortar as directed by the COR. Air entrain concrete exposed to weather using an air-entraining admixture conforming to ASTM C260/C260M. Air content shall be between 4 and 6 percent.

2.7 SOURCE QUALITY CONTROL

2.7.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the COR 30 calendar days before scheduled test date. Notify COR 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

1. The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

3. Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.

4. Dated calibration labels shall be visible on all test equipment.

5. Calibrating standard shall be of higher accuracy than that of the instrument tested.

6. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

   (a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

   (b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.7.2 Design Tests

IEEE C57.12.00, and IEEE C57.12.90. Section 5.1.2 in IEEE C57.12.80 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for the specified transformer(s). Perform design tests prior to the award of this contract.

a. Tests shall be certified and signed by a registered professional engineer.

b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (ONAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.

c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include the primary windings only of that transformer.

   1. IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.

   2. State test voltage levels.

   3. Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with IEEE C57.12.34.

e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

f. Short circuit: "Basically the same design" for the short circuit test means a pad-mounted transformer with the same kVA as the transformer

specified.

2.7.3 Routine and Other Tests

IEEE C57.12.00. Routine and other tests shall be performed by the manufacturer on the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence shall be as follows:

a. Cold resistance measurements (provide reference temperature)

b. Phase relation

c. Ratio

d. No-load losses (NLL) and excitation current

e. Load losses (LL) and impedance voltage

f. Dielectric

1. Impulse

2. Applied voltage

3. Induced voltage

g. Leak

h. Dissolved gas analysis (DGA)

2.7.4 PREDICTIVE & ACCEPTANCE TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, CEC, and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

CEC and IEEE C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as shown on drawings. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld (underground) or compression connector (above ground).

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.4 FIELD APPLIED PAINTING

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.5 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.6 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab. Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Place the slab on a 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade shall have 1/2 inch chamfer. Slab shall be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.6.1 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.7 FIELD QUALITY CONTROL

3.7.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.7.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

1. Compare equipment nameplate information with specifications and approved shop drawings.

2. Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

3. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

4. Verify correct liquid level in tanks.

5. Perform specific inspections and mechanical tests as recommended by manufacturer.

6. Verify correct equipment grounding.

7. Verify the presence of transformer surge arresters.

b. Electrical tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter.

2. Verify that the tap-changer is set at specified ratio.

3. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3.7.1.2 Current Transformers

a. Electrical tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

2. Perform insulation-resistance test.

3. Perform a polarity test.

4. Perform a ratio-verification test.

3.7.1.3 Grounding System

a. Visual and mechanical inspection

1. Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

1. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. Equip the instrument with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

2. Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.7.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the COR shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

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SWITCHBOARDS

PART 1 GENERAL

1.1 SUMMARY

This section covers free standing deadfront switchboard assemblies rated 6000 amperes or less, 600 volts or less, and metal-enclosed low-voltage power circuit-breaker switchgear assemblies in either interior or exterior locations.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C39.1	Requirements for Electrical Analog Indicating Instruments

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM B 187/B 187M	Standard Specification for Copper, Bus Bar, Rod and Shapes and General Purpose Rod, Bar and Shapes
ASTM D 149	Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

ASTM D 1535	Specifying Color by the Munsell System
ASTM D 709	Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C2	National Electrical Safety Code
IEEE C37.13	Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C57.12.01	General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid-Cast and/or Resin-Encapsulated Windings
IEEE C57.12.28	Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.13	Standard Requirements for Instrument Transformers
IEEE Stds Dictionary	IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	Electric Meters Code for Electricity Metering
ANSI/NEMA PB 2.1	General Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 V or Less
NEMA ICS 6	Enclosures
NEMA LI 1	Industrial Laminating Thermosetting Products
NEMA PB 2	Deadfront Distribution Switchboards

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 467	Grounding and Bonding Equipment
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 891	Switchboards

1.3 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.4 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, use as defined in IEEE Stds Dictionary.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switchboard Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate within the drawings adequate clearance for operation, maintenance, and replacement of operating equipment devices. Include submittals for the nameplate data, size, and capacity. Also include submittals for applicable federal, military, industry, and technical society publication references.

SD-03 Product Data

Switchboard

SD-06 Test Reports

Switchboard Design Tests

Switchboard Production Tests

Acceptance Checks And Tests

SD-10 Operation and Maintenance Data

Switchboard Operation and Maintenance, Data Package 5

SD-11 Closeout Submittals

Assembled Operation and Maintenance Manuals

Equipment Test Schedule

Request for Settings

1.6 QUALITY ASSURANCE

1.6.1 Predictive Testing And Inspection Technology Requirements

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.6.2 Switchboard Product Data

Each submittal shall include manufacturer's information for each component, device and accessory provided with the switchboard including:

a. Circuit breaker type, interrupting rating, and trip devices, including available settings

b. Manufacturer's instruction manuals and published time-current curves (on full size logarithmic paper) of the main secondary breaker and largest secondary feeder device.

1.6.3 Switchboard Drawings

Drawings shall include, but are not limited to the following:

a. One-line diagram including breakers, fuses, current transformers, and meters

b. Outline drawings including front elevation, section views, footprint, and overall dimensions

c. Bus configuration including dimensions and ampere ratings of bus bars

d. Markings and NEMA nameplate data, including fuse information (manufacturer's name, catalog number, and ratings)

e. Circuit breaker type, interrupting rating, and trip devices, including available settings

f. Three-line diagrams and elementary diagrams and wiring diagrams with

terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.

g. Manufacturer's instruction manuals and published time-current curves (on full size logarithmic paper) of the main secondary breaker and largest secondary feeder device. These shall be used by the designer of record to provide breaker settings that will ensure protection and coordination are achieved.

h. Provisions for future extension.

1.6.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the COR. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of CEC unless more stringent requirements are specified or indicated.

1.6.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.5.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than 3 years prior to date of delivery to site, unless specified otherwise.

1.7 MAINTENANCE

1.7.1 Switchboard Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.7.2 Assembled Operation and Maintenance Manuals

Assemble and bind manuals securely in durable, hard covered, water resistant binders. Assemble and index the manuals in the following order

with a table of contents. The contents of the assembled operation and maintenance manuals shall be as follows:

a. Manufacturer's O&M information required by the paragraph entitled "SD-10, Operation and Maintenance Data".

b. Catalog data required by the paragraph entitled, "SD-03, Product Data".

c. Drawings required by the paragraph entitled, "SD-02, Shop Drawings".

d. Prices for spare parts and supply list.

e. Information on metering

f. Design test reports

g. Production test reports

1.7.3 Spare Parts

Furnish spare parts as specified below. All spare parts shall be of the same material and workmanship, shall meet the same requirements, and shall be interchangeable with the corresponding original parts furnished.

a. 2 - Breakers of each type and size.

1.8 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be switchboards switchgear and related accessories are specified in Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL.

2.2 SWITCHBOARD

NEMA PB 2 and UL 891.

2.2.1 Ratings

The voltage rating of the switchboard shall be 480Y/277 volts AC, 4-wire 3 phase as indicated. The continuous current rating of the main bus shall be 2500 amperes as indicated . The short-circuit current rating shall be 65KA rms symmetrical amperes as indicated . The switchboard shall be UL listed and labeled for its intended use as service entrance equipment.

2.2.2 Construction

The switchboards shall be dead-front switchboards conforming to NEMA PB 2 and labeled under UL 891. The switchboards shall be completely enclosed self-supporting metal structures with the required number of vertical panel sections, buses, molded-case circuit breakers, and other devices as shown

on the drawings. Switchboards shall be fully rated for a short-circuit current of 65,000 symmetrical amperes RMS AC.

Switchboard shall consist of vertical sections bolted together to form a rigid assembly and shall be front and rear aligned as indicated. All circuit breakers are to be front accessible. Front and rear aligned switchboards are to have rear accessible load connections. Compartmentalized switchboards shall have vertical insulating barriers between the front device section, the main bus section, and the cable compartment with full front to rear vertical insulating barriers between adjacent sections. Where indicated, "space for future" or "space" shall mean to include bus, device supports, and connections. Provide insulating barriers in accordance with NEMA LI 1, Type GPO-3, 0.25 inch minimum thickness. Apply moisture resistant coating to all rough-cut edges of barriers. Switchboard shall be completely factory engineered and assembled, including protective devices and equipment indicated with necessary interconnections, instrumentation, and control wiring.

2.2.2.1 Enclosure

The switchboard enclosure shall be a outdoor NEMA ICS 6 Type 3R as indicated. Enclosure shall be bolted together with removable bolt-on side and hinged rear covers, and sloping roof downward toward rear. Front and rear doors shall be provided with stainless steel padlockable vault handles with a three point catch. Bases, frames and channels of enclosure shall be corrosion resistant and shall be fabricated of galvanized steel. Base shall include any part of enclosure that is within 3 inches of concrete pad. Galvanized steel shall be ASTM A123/A123M, ASTM A653/A653M G90 coating, and ASTM A153/A153M, as applicable. Galvanize after fabrication where practicable. Paint enclosure, including bases, ASTM D 1535 light gray No. 61 or No. 49. Paint coating system shall comply with IEEE C57.12.28 for galvanized steel.

Each switchboard enclosure shall be NEMA type 3R, built with selected smooth sheet steel panels of not less than No. 14 gage. Exposed panels on the front and ends shall have bent angle or channel edges with all corner seams welded and ground smooth. The front outside surfaces shall not be drilled or welded for the purpose of attaching wires or mounting devices if such holes or fastenings will be visible from the front. The front panels shall be made in sections flanged on four sides and attached to the framework by screws and arranged for ready removal for inspection or maintenance. Rear access to the bus and device connections shall be provided. Ventilating openings shall be provided as required and shall preferably be of the grille type. All ventilating openings shall be provided with corrosion-resistant insect-proof screens on the inside. Each switchboard shall be provided with a channel iron base at front, rear, and sides, with exposed ends covered by welded steel plates. Grout holes shall be provided. Bolt the switchboard sections to the base. Mount switchboards as shown on the drawings and furnish mounting materials as indicated. Treat all interior and exterior steel parts to inhibit corrosion and paint.

2.2.2.2 Bus Bars

Bus bars shall be copper with silver-plated contact surfaces. Plating shall be a minimum of 0.0002 inch thick. Make bus connections and joints with hardened steel bolts. The through-bus shall be rated at the full ampacity of the main throughout the switchboard. Provide minimum one-quarter by 2 inch copper ground bus secured to each vertical section

along the entire length of the switchboard. The neutral bus shall be rated 100 percent of the main bus continuous current rating as indicated. Phase bus bars shall be insulated with an epoxy finish coating powder providing a minimum breakdown voltage of 16,000 volts per ASTM D 149.

All buses shall be of copper and all bolted splices and connections between buses and for extensions or taps for equipment shall be tin or silver-plated throughout. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B 187/B 187M. All splices for field assembly shall be bolted with at least two bolts and shall employ the use of "Belleville" washers in the connection. Horizontal and vertical power buses have minimum current ratings as shown on the drawings. The buses shall be insulated for not less than 600 volts. Shop splices and tap connections shall be brazed, pressure-welded or bolted. All splices for field assembly shall be bolted. Mount the buses on insulating supports of wet process porcelain, glass polyester, or suitable molded material, and brace to withstand not less than 65,000 symmetrical amperes ac. A copper ground bus, rated not less than 300 amps, extending the entire length of the assembled structure, shall be mounted near the bottom of enclosure. A full clamp-type solderless copper or copper alloy lug for No. 2/0 AWG stranded copper cable shall be provided at each end of the bus for connection to the station grounding system.

2.2.2.3 Main Section

The main section shall consist of insulated-case circuit breaker and utility transformer compartment.

2.2.2.4 Distribution Sections

The distribution sections shall consist of individually mounted, insulated-case circuit breakers as indicated.

2.2.2.5 Auxiliary Sections

Auxiliary sections shall consist of indicated instruments, control equipment, transformer, and current transformer compartments as indicated.

2.2.2.6 Handles

Handles for individually mounted devices shall be of the same design and method of external operation. Label handles prominently to indicate device ampere rating, color coded for device type. Identify ON-OFF indication by handle position and by prominent marking.

2.2.3 Protective Device

Provide main and branch protective devices as indicated.

2.2.3.1 Power Circuit Breaker

IEEE C37.13. Manually operated stationary drawout, unfused low-voltage power circuit breaker with a short-circuit current rating of 65,000 rms amperes symmetrical as indicated at 480 volts. Breaker frame size shall be as indicated 2500 amperes. Equip electrically operated breakers with motor-charged, stored-energy closing mechanism to permit rapid and safe closing of the breaker against fault currents within the short time rating of the breaker, independent of the operator's strength or effort in closing

the handle.

2.2.3.2 Insulated-Case Breaker

UL listed, 100 percent rated, drawout circuit breaker, with a short-circuit current rating of 65KA rms symmetrical amperes as indicated at 480 volts. Breaker frame size is to be as indicated. Equip electrically operated breaker with motor-charged, stored-energy closing mechanism to permit rapid and safe closing of the breaker against fault currents within the short time rating of the breaker, independent of the operator's strength or effort in closing the handle.

2.2.3.3 Molded-Case Circuit Breaker

UL 489. UL listed and labeled, 100 percent rated, stationary, 120 Vac, electrically manually operated, low voltage molded-case circuit breaker, with a short-circuit current rating of 65KA rms symmetrical amperes as indicated at 480 volts. Breaker frame size is to be as indicated. Series rated circuit breakers are unacceptable.

Equip each switchboard with molded-case circuit breakers with trip ratings and terminal connectors for attachment of outgoing power cables as shown on the drawings. The circuit breakers shall be operable and removable from the front. Where shown on the drawings, enclose circuit breakers in individual compartments.

2.2.4 Drawout Breakers

Equip drawout breakers with disconnecting contacts, wheels, and interlocks for drawout application. The main, auxiliary, and control disconnecting contacts are to be silver-plated, multifinger, positive pressure, self-aligning type. Provide each drawout breaker with four-position operation. Clearly identify each position by an indicator on the circuit breaker front panel.

a. Connected Position: Primary and secondary contacts are fully engaged. Breaker must be tripped before racking into or out of position.

b. Test Position: Primary contacts are disconnected but secondary contacts remain fully engaged. Position shall allow complete test and operation of the breaker without energizing the primary circuit.

c. Disconnected Position: Primary and secondary contacts are disconnected.

d. Withdrawn (Removed) Position: Places breaker completely out of compartment, ready for removal. Removal of the breaker shall actuate assembly that isolates the primary stabs.

2.2.5 Electronic Trip Units

Equip main and distribution breakers as indicated with a solid-state tripping system consisting of three current sensors and a microprocessor-based trip unit that will provide true rms sensing adjustable time-current circuit protection. The ampere rating of the current sensors are to be the same as the breaker frame rating. The trip unit ampere rating shall be as indicated. Ground fault protection shall be residual type sensing. The electronic trip units shall have the following features.

a. Breakers shall have long delay pick-up and time settings, and LED indication of cause of circuit breaker trip.

b. Main breakers shall have short delay pick-up and time settings, instantaneous settings, and ground fault settings.

c. Distribution breakers shall have short delay pick-up and time settings, instantaneous settings, and ground fault settings.

d. Main Breakers shall have a digital display for phase and ground current.

e. Main Breakers shall have a digital display for watts, vars, VA, kWh, kvarh, and kVAh.

f. Main Breakers shall have a digital display for phase voltage, and percent THD voltage and current.

g. Main Breakers shall have provisions for communication via a network twisted pair cable for remote monitoring and control.

2.2.6 Electronic Trip Unit Central Monitor

Provide a microprocessor-based device designed to monitor and display parameters of the circuit breaker electronic trip units. The central monitor shall have the following features:

a. Alphanumeric display.

b. Indication of circuit breaker status; tripped, open, closed.

c. Cause of circuit breaker trip.

d. Phase, neutral, and ground current for each breaker.

e. Energy parameters for each breaker.

f. Provisions for communicating directly to a remote computer.

2.2.7 Instruments

ANSI C39.1 for electrical indicating switchboard instruments, with 2 percent accuracy. The ac ammeters and voltmeters shall be a minimum of 2 inches square, with 250-degree scale. Provide single phase indicating instruments with flush-mounted transfer switches for reading three phases.

2.2.7.1 Ac Ammeters

Self-contained.

2.2.7.2 Ac Voltmeters

Self-contained.

2.2.7.3 Instrument Control Switches

Provide rotary cam-operated type with positive means of indicating contact positions. Switches shall have silver-to-silver contacts enclosed in a protective cover which can be removed to inspect the contacts.

2.2.8 Current Transformers

IEEE C57.13. Transformers shall be single ratio, 60 hertz, 2500 to 5-ampere ratio, 1.5 rating factor, with a metering accuracy class of 0.3 through 1.8.

2.2.9 Transformer

Provide transformer section in switchboard in accordance with UL 891 and as indicated. The transformer and section shall be suitable for the installation. Transformers greater than 10 kVA shall be tested in accordance with UL 891. Transformer shall conform to the requirements of Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL.

2.2.10 Meter Fusing

Provide a fuse block mounted in the metering compartment containing one fuse per phase to protect the voltage input to voltage sensing meters. Size fuses as recommended by the meter manufacturer.

2.2.11 Heaters

Provide 120-volt heaters in each switchboard section. Heaters shall be of sufficient capacity to control moisture condensation in the section, shall be 250 watts minimum, and shall be controlled by a thermostat and humidistat located in the section. Thermostat shall be industrial type, high limit, to maintain sections within the range of 60 to 90 degrees F. Humidistat shall have a range of 30 to 60 percent relative humidity. Supply voltage for the heaters shall be obtained from a control power transformer within the switchboard. If heater voltage is different than switchboard voltage, provide transformer rated to carry 125 percent of heater full load rating. Transformer shall have 220 degrees C insulation system with a temperature rise not exceeding 115 degrees C and shall conform to IEEE C57.12.01. Energize electric heaters in switchboard assemblies while the equipment is in storage or in place prior to being placed in service. Provide method for easy connection of heater to external power source. Provide temporary, reliable external power source if commercial power at rated voltage is not available on site.

2.2.12 Terminal Boards

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Terminal boards associated with current transformers shall be short-circuiting type. Terminate conductors for current transformers with ring-tongue lugs. Terminal board identification shall be identical in similar units. External wiring shall be color coded consistently for similar terminal boards.

2.2.13 Wire Marking

Mark control and metering conductors at each end. Provide factory-installed, white, plastic tubing, heat stamped with black block type letters on factory-installed wiring. On field-installed wiring, provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Each sleeve shall contain a single letter or number, shall be elliptically shaped to securely grip the wire, and shall be keyed in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of

individual sleeves. Each wire marker shall indicate the device or equipment, including specific terminal number to which the remote end of the wire is attached.

2.3 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable. This nameplate and method of attachment may be the manufacturer's standard if it contains the required information.

2.4 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each switchboard equipment enclosure, relay, switch, and device; as specified in this section or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Provide red laminated plastic label with white center core where indicated. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.5 SOURCE QUALITY CONTROL

2.5.1 Equipment Test Schedule

The Government reserves the right to witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the COR 30 calendar days before scheduled test date. Notify COR 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

1. The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

3. Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.

4. Dated calibration labels shall be visible on all test equipment.

5. Calibrating standard shall be of higher accuracy than that of the instrument tested.

6. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

   (a) Maintain up-to-date instrument calibration instructions and

procedures for each test instrument.

(b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.5.2 Switchboard Design Tests

NEMA PB 2 and UL 891.

2.5.2.1 Design Tests

Furnish documentation showing the results of design tests on a product of the same series and rating as that provided by this specification.

a. Short-circuit current test

b. Enclosure tests

c. Dielectric test

2.5.3 Switchboard Production Tests

NEMA PB 2 and UL 891. Furnish reports which include results of production tests performed on the actual equipment for this project. These tests include:

a. 60-hertz dielectric tests

b. Mechanical operation tests

c. Electrical operation and control wiring tests

d. Ground fault sensing equipment test

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, CEC, and to the requirements specified herein.

3.2 GROUNDING

CEC and IEEE C2, except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in the drawing. Connect ground conductors to the upper end of the ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Equipment Grounding

Provide bare copper cable not smaller than No. 4/0 AWG not less than 24 inches below grade connecting to the indicated ground rods. When work in addition to that indicated or specified is directed to obtain the specified ground resistance, the provision of the contract covering "Changes" shall

apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector, paragraph entitled, "Grounding Connections."

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect equipment furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Switchboard

ANSI/NEMA PB 2.1.

3.3.2 Meters and Instrument Transformers

ANSI C12.1.

3.3.3 Field Applied Painting

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.3.4 Galvanizing Repair

Repair damage to galvanized coatings using ASTM A780/A780M, zinc rich paint, for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces that repair paint has been applied to.

3.3.5 Field Fabricated Nameplate Mounting

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

3.4.1 Exterior Location

Mount switchboard on concrete slab. Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 inch No. 6 mesh placed uniformly 4 inchesfrom the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. The top of the concrete slab shall be approximately 4 inches above the finished grade. Edges above grade shall have 1/2 inch chamfer. The slab shall be of adequate size to project at least 8 inches beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 3 inches above slab surface. Concrete work shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE

3.5 FIELD QUALITY CONTROL

Contractor shall submit request for settings of breakers to the COR after approval of switchboard and at least 30 days in advance of their requirement.

3.5.1 Performance of Acceptance Checks and Tests

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.5.1.1 Switchboard Assemblies

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical, electrical, and mechanical condition.

3. Confirm correct application of manufacturer's recommended lubricants.

4. Verify appropriate anchorage, required area clearances, and correct alignment.

5. Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.

6. Verify that circuit breaker sizes and types correspond to approved shop drawings.

7. Verify that current transformer ratios correspond to approved shop drawings.

8. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

9. Confirm correct operation and sequencing of electrical and mechanical interlock systems.

10. Clean switchboard.

11. Inspect insulators for evidence of physical damage or contaminated surfaces.

12. Verify correct barrier installation and operation.

13. Exercise all active components.

14. Inspect all mechanical indicating devices for correct operation.

15. Verify that vents are clear.

16. Test operation, alignment, and penetration of instrument transformer withdrawal disconnects.

17. Inspect control power transformers.

b. Electrical Tests

1. Perform insulation-resistance tests on each bus section.

2. Perform overpotential tests.

3. Perform insulation-resistance test on control wiring; Do not perform this test on wiring connected to solid-state components.

4. Perform control wiring performance test.

5. Perform primary current injection tests on the entire current circuit in each section of assembly.

6. Perform phasing check on double-ended switchboard to ensure correct bus phasing from each source.

7. Verify operation of switchboard heaters.

3.5.1.2 Circuit Breakers - Low Voltage - Power

a. Visual and Mechanical Inspection

1. Compare nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Confirm correct application of manufacturer's recommended lubricants.

4. Inspect anchorage, alignment, and grounding. Inspect arc chutes. Inspect moving and stationary contacts for condition, wear, and alignment.

5. Verify that all maintenance devices are available for servicing and operating the breaker.

6. Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.

7. Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism.

8. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

9. Verify cell fit and element alignment.

10. Verify racking mechanism.

b. Electrical Tests

1. Perform contact-resistance tests on each breaker.

2. Perform insulation-resistance tests.

3. Adjust Breaker(s) for final settings in accordance with Government provided settings.

4... Determine long-time minimum pickup current by primary current injection.

5. Determine long-time delay by primary current injection.

6. Determine short-time pickup and delay by primary current injection.

7. Determine ground-fault pickup and delay by primary current injection.

8. Determine instantaneous pickup value by primary current injection.

9. Activate auxiliary protective devices, such as ground-fault or undervoltage relays, to ensure operation of shunt trip devices; Check the operation of electrically-operated breakers in their cubicle.

10. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.

11. Verify operation of charging mechanism.

3.5.1.3 Circuit Breakers

Low Voltage - Insulated-Case and Low Voltage Molded Case with Solid State Trips

a. Visual and Mechanical Inspection

1. Compare nameplate data with specifications and approved shop drawings.

2. Inspect circuit breaker for correct mounting.

3. Operate circuit breaker to ensure smooth operation.

4. Inspect case for cracks or other defects.

5. Inspect all bolted electrical connections for high resistance using low resistance ohmmeter, verifying tightness of accessible bolted connections and/or cable connections by calibrated torque-wrench method, or performing thermographic survey.

6. Inspect mechanism contacts and arc chutes in unsealed units.

b. Electrical Tests

1. Perform contact-resistance tests.

2. Perform insulation-resistance tests.

3. Perform Breaker adjustments for final settings in accordance with Government provided settings.

4. Perform long-time delay time-current characteristic tests.

5. Determine short-time pickup and delay by primary current injection.

6. Determine ground-fault pickup and time delay by primary current injection.

7. Determine instantaneous pickup current by primary injection.

8. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and anti-pump function.

3.5.1.4 Current Transformers

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify correct connection.

4. Verify that adequate clearances exist between primary and secondary circuit.

5. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

6. Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

2. Perform insulation-resistance tests.

3. Perform polarity tests.

4. Perform ratio-verification tests.

3.5.1.5 Metering and Instrumentation

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify tightness of electrical connections.

b. Electrical Tests

1. Determine accuracy of meters at 25, 50, 75, and 100 percent of full scale.

2. Calibrate watthour meters according to manufacturer's published data.

3. Verify all instrument multipliers.

4. Electrically confirm that current transformer and voltage transformer secondary circuits are intact.

3.5.1.6 Grounding System

a. Visual and Mechanical Inspection

1. Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

1. IEEE 81. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

2. Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.5.2 Follow-Up Verification

Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. Circuit breakers shall be tripped by operation of each protective device. Test shall require each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract, the COR shall be given 5 working days advance notice of the dates and times for checks, settings, and tests.

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SECTION 26 24 16.00 40

PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

This section covers power-distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA PB 1	Panelboards

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	Colors Used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 67	Standard for Panelboards

1.3 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Detail Drawings for the panelboards consisting of fabrication and assembly drawings for all parts of the work in sufficient detail to enable the Government to check conformity with the requirements of the contract documents. Include within drawings details of bus layout.

Ensure Outline Drawings for panelboards indicate overall physical features, dimensions, ratings, service requirements, and weights of equipment.

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system or material meet specified requirements. Statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit Detail Drawings and Outline Drawings for panelboards in accordance with paragraph entitled, "General Requirements," of this section.

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Panelboards

Directory Card and Holder

Filtered Panelboard

SD-04 Samples

Ensure that Keys are properly tagged and delivered to the COR.

SD-06 Test Reports

Submit test reports for the following tests in accordance with the paragraph entitled, "Site Testing," of this section. Do not energize panelboards until the recorded test data has been submitted to and approved by the COR.

Continuity Tests

Insulation Tests

SD-07 Certificates

Submit Statements in accordance with paragraph entitled, "General Requirements," of this section.

SD-08 Manufacturer's Instructions

Submit manufacturer's instructions for Panelboards including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

1.5 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

PART 2 PRODUCTS

2.1 PANELBOARDS

Totally enclose power-distribution panelboards and lighting and appliance branch-circuit panelboards in a steel cabinet, dead-front circuit breaker type with copper buses, surface- or flush-mounted as indicated. Ensure panelboards conform to NEMA PB 1 and UL 489. Branch circuit panels shall have buses fabricated for bolt-on type circuit breakers.

An outer door or cover, hinged on one side, shall be provided on surface-mounted panelboards to provide gutter space access. Provide a center door for circuit breaker/switch access only.

Voltage and current rating, number of phases, and number of wires shall be as indicated. Provide four-wire distribution panelboards and lighting and appliance branch-circuit panelboards with an isolated full-capacity neutral bus. Ensure panelboards are rated for 120/208-volt, three-phase and 277/480-volt, three-phase, 60-hertz current.

Provide three-phase, 4-wire distribution lighting and branch circuit panelboards with an isolated full-capacity bus providing spaces for single-pole circuit breakers/switches and spaces indicated as spare.

Provide panelboards with a separate grounding bus bonded to the enclosure. Grounding bus shall be a solid bus bar of rectangular cross section equipped with binding screws for the connection of equipment grounding conductors.

Each panelboard, as a complete unit, shall have a short-circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or as indicated.

Ensure panelboards and main lugs or main breaker have current ratings as shown on the panelboard schedule.

Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type. Single-phase, three-wire panelboard busing shall be such that when any two adjacent single-pole breakers are connected to opposite phases, two-pole breakers can be installed in any location. Three-phase, four-wire busing shall be such that when any three adjacent single-pole breakers are individually connected to each of the three different phases, two- or three-pole breakers can be installed at any location. Current-carrying parts of the

bus assembly shall be plated. Mains ratings shall be as shown.

Mechanical lugs furnished with panelboards shall be cast copper or copper alloys of sizes suitable for the conductors indicated to be connected thereto.

Boxes shall have the manufacturer's standard knockouts and shall be galvanized code-gage sheet steel. Fronts shall be of code-gage sheet steel furnished with hinged doors with adjustable trim clamps for securing the fronts to the boxes.

Panelboard box shall be galvanized rust-resistant code-gage sheet steel without knockouts. Ensure entire panelboard front is hinged on one side with a piano hinge for the full height and has captive screws opposite the hinged side. Where panelboards are installed flush with the walls, the installation details shall be such that the hinged front can be opened without damage to the adjacent wall surfaces. Ensure that the color of the finished coat of trim and front matches the adjacent walls except when the box is installed in electrical closets or equipment rooms, the gray finish as specified is acceptable.

Panelboard enclosures shall be NEMA 250, Type 1. Provide enclosures with hinged fronts and corrosion-resistant steel pin-tumbler cylinder locks. Key locks alike and provide two keys for each enclosure.

Finish panelboards with baked enamel. Finish color is to be No. 61 gray conforming to FED-STD-595.

2.2 CIRCUIT BREAKERS

Circuit breakers shall be the molded-case type as specified in Section 26 05 71.00 40 LOW VOLTAGE OVERCORRECT PROTECTIVE DEVICES. Frame and trip ratings shall be as indicated.

Interrupting rating of circuit breakers shall be as indicated. If not shown, the interrupting rating for circuit breakers in 120/208-volt panelboards shall be not less than 10,000 amperes rms symmetrical, and that for breakers in 277/480-volt panelboards shall be not less than 25,000 amperes rms symmetrical.

Circuit breakers shall be bolt-on type. Plug-in type is not acceptable.

Provide shunt trips where indicated.

In branch circuit panelboards, branch circuit breakers feeding convenience outlets shall have sensitive instantaneous trip settings of not more than 10 times the trip rating of the breaker to prevent repeated arcing shorts resulting from frayed appliance cords. Single-pole 15- and 20-ampere circuit breakers shall be UL listed as "Switching Breakers" at 120 volts ac. Provide UL Class A (5-milliampere sensitivity) ground fault circuit protection on 120-volt ac branch circuit as indicated. This protection is an integral part of the branch circuit breaker that also provides overload and short-circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption is not to disturb the feeder circuit to the panelboard. A single-pole circuit breaker with integral ground fault circuit interruption requires no more panelboard branch circuit space than a conventional slide pole circuit breaker.

Ensure connections to the bus are bolt-on type.

When multiple wires per phase are specified, furnish the circuit breakers with connectors made to accommodate multiple wires.

Ensure circuit breaker spaces called out on the drawings are complete with mounting hardware to permit ready installation of the circuit breakers.

2.3 DIRECTORY CARD AND HOLDER

Mount a directory card on the inside of hinged fronts and doors under glass 0.030-inch thick minimum plastic in a metal frame, with spaces for circuit numbers, outlets controlled, and room numbers. Directory card shall identify each branch circuit with its respective and numbered circuit breaker.

2.4 FACTORY TESTING

Test complete panelboards in accordance with UL 67.

2.5 PRECAUTIONARY LABEL

To ensure persons are aware of immediate or potential hazard in the application, installation, use, or maintenance of panelboards, each panelboard shall be conspicuously marked on the trim or dead front shield with the text (or equivalent) **DANGER** symbol. If the panel is supplied with a door, ensure the label is visible when the door is in the open position.

PART 3 EXECUTION

3.1 INSTALLATION

Install panelboards as indicated and in accordance with the manufacturer's instructions. Fully align and mount panels so that the height of the top operating handle does not exceed 72-inches above the finished floor.

Directory-card information shall be typewritten in capital letters to indicate outlets controlled and final room numbers served by each circuit and shall be mounted in holders behind protective covering.

3.2 SITE TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Each panelboard enclosure key shall be shown to operate the enclosure locks in the presence of the COR.

Panelboards shall be given continuity and insulation tests after the installation has been completed and before the panelboard is energized.

Provide test equipment, labor, and personnel as required to perform the tests as specified. Conduct Continuity tests using a dc device with bell.

Conduct insulation tests on 480-volt panelboards using a 1,000-volt insulation-resistance test set. Record readings every minute until three equal and consecutive readings have been obtained. Resistance between phase conductors and between phase conductors and ground shall be not less than 50 megohms.

Conduct insulation tests on panelboards rated 300 volts or less using a 500-volt minimum insulation-resistance test set. Record readings after 1 minute and until the reading is constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Record test data and include the location and identification of panelboards and megohm readings versus time.

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MOTOR CONTROL CENTERS

PART 1 GENERAL

1.1 SUMMARY

This section covers motor control centers and switchboards by formal advertising, using a SUPPLY-type contract.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASME INTERNATIONAL (ASME)

ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	Pipe Threads, General Purpose (Inch)

ASTM INTERNATIONAL (ASTM)

ASTM B 187/B 187M	Standard Specification for Copper, Bus Bar, Rod and Shapes and General Purpose Rod, Bar and Shapes

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.13	Standard Requirements for Instrument Transformers

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 4	Terminal Blocks

NEMA ICS 6	Enclosures
NEMA ST 1	Specialty Transformers (Except General Purpose Type)
NEMA/ANSI C12.11	Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1063	Machine-Tool Wires and Cables
UL 44	Thermoset-Insulated Wires and Cables
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 845	Motor Control Centers

1.3 SYSTEM DESCRIPTION

These specifications include the design, fabrication, assembly, wiring, testing, delivery, installation and testing of the items of equipment and accessories and spare parts listed in the Schedule and shown on the drawings.

Within 30 calendar days after date of receipt by him of notice of award, submit for the approval of the COR six (6) copies of electrical equipment drawings, including all switchboards, motor control units, and protective devices. Provide a single-line diagram, equipment list and nameplate schedule.

Submit an individual wiring diagram for each motor control center. Wiring diagrams shall be in a form showing physical arrangement of the control center with interconnecting wiring shown by lines or by terminal designations (wireless). Provide a single-line diagram, equipment list and nameplate schedule for each motor control center.

1.3.1 Rules

The equipment shall conform to the requirements of CEC unless more stringent requirements are indicated herein or shown. NEMA rated and UL listed equipment has been specified when available. Equipment must meet NEMA and UL construction and rating requirements as specified. No equivalent will be acceptable. Immediately notify the COR of any requirements of the specifications or Contractor proposed materials or assemblies that do not comply with UL or NEMA. International Electrotechnical Commission (IEC) rated equipment will not be considered an acceptable alternative to specified NEMA ratings.

1.3.2 Coordination

The general arrangement of the motor control centers is shown on the contract drawings. Any modifications of the equipment arrangement or

device requirements as shown on the drawings is subject to the approval of the COR. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. Completely assemble all equipment at the factory. The motor control centers may be disassembled into sections, if necessary, for convenience of handling, shipping, and installation.

1.3.3 Standard Products

Material and equipment shall be standard products of a manufacturer regularly engaged in their manufacture and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. All materials shall conform to the requirements of these specifications. Materials are to be of high quality, free from defects and imperfections, of recent manufacture, and of the classification and grades designated. All materials, supplies, and articles not manufactured by the Contractor shall be the products of other recognized reputable manufacturers. If the Contractor desites for any reason to deviate from the standards designated in these specifications, he shall, after award, submit a statement of the exact nature of the deviation, and shall submit, for the approval of the COR, complete specifications for the materials which he proposes to use.

1.3.4 Nameplates

Make nameplates of laminated sheet plastic or of anodized aluminum approximately 1/8 inch thick, engraved to provide white letters on a black background. Fasten the nameplates to the equipment in proper positions with anodized round-head screws. Lettering shall be minimum 1/2 inch high. Nameplate designations shall be in accordance with lists on the drawings, and as a minimum provide for the following equipment:

a. Motor Control Centers

b. Individual items of equipment mounted in the Motor Control Centers

Provide equipment of the withdrawal type with nameplates mounted on the removable equipment in locations visible when the equipment is in place.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings

Shop Drawings

Within 30 calendar days after date of award, submit for the approval of the COR six (6) copies of outline drawings of all equipment to be furnished under this contract, together with weights and overall dimensions. Drawings shall show the general arrangement and overall dimensions of the motor control centers. These drawings shall show space requirements, details of any floor supports to be embedded in concrete and provisions for conduits for external cables.

Motor Control Centers

Switchboards

SD-03 Product Data

Equipment

Within 30 calendar days after date of receipt by him of notice of award submit for approval six (6) copies of such descriptive cuts and information as are required to demonstrate fully that all parts of the equipment will conform to the requirements and intent of the specifications. Data shall include descriptive data showing typical construction of the types of equipment proposed, including the manufacturer's name, type of molded case circuit breakers or motor circuit protectors, performance capacities and other information pertaining to the equipment. Submit six (6) sets of characteristic curves of the individual breaker trip element.

Factory Tests

Submit, within a minimum of 14 days prior to the proposed date of tests, six (6) copies of manufacturer's routine factory test procedures and production line tests for all motor control centers.

SD-06 Test Reports

Factory Tests

Submit six (6) complete reproducible copies of the factory inspection results and six (6) complete reproducible copies of the factory test results in booklet form, including all plotted data curves, all test conditions, a listing of test equipment complete with calibration certifications, and all measurements taken. Contractor's and COR's Representatives must sign and date report.

SD-07 Certificates

Motor Control Centers

Submit certification of factory test reports. Certification shall be signed by official authorized to certify on behalf of the manufacturer, attesting that the motor control center meets the specified requirements. The statement must be dated after the award of this contract, must state the Contractors name and address, must name the project and location, and must list the specific requirements which are being certified.

SD-08 Manufacturer's Instructions

Submit manufacturer's instructions for the following including special provisions required to install equipment components and system packages. Detail within special notices hazards and safety precautions.

Motor Control Units

Protective Devices

1.5 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.6 DELIVERY, STORAGE, AND HANDLING

Ship the equipment as completely assembled and wired as feasible so as to require a minimum of installation work. Each shipping section shall be properly match marked to facilitate reassembly, and shall be provided with removable lifting channels with eye bolts for attachment of crane slings to facilitate lifting and handling. Any relay or other device which cannot withstand the hazards of shipment when mounted in place on the equipment shall be carefully packed and shipped separately. Mark these devices with the number of the panel which they are to be mounted on and fully identified. All finished painted surfaces and metal work shall be wrapped suitably or otherwise protected from damage during shipment. Prepare all parts for shipment so that slings for handling may be attached readily while the parts are in a railway car or transport truck. Carefully package and clearly mark all spare parts and accessories.

1.7 MAINTENANCE

1.7.1 Accessories and Tools

A complete set of accessories and special tools unique to equipment provided and required for erecting, handling, dismantling, testing and maintaining the apparatus to be furnished by the Contractor.

1.7.2 Spare Parts

Furnish spare parts as specified below. All spare parts shall be of the same material and workmanship, shall meet the same requirements, and shall be interchangeable with the corresponding original parts furnished.

1 - Circuit breaker auxiliary switch.

b. 2 - Operating coils for each size ac contactor.

e. c - Complete sets of 3-pole stationary and moving contact assemblies for each size ac contactor.

g. d - Contactor overload relays of each type and rating, each relay with a complete set of contact blocks.

e. 1 - Spare set of heater elements for each heater rating provided.

f. 2 - Indicating lamp assemblies of each type.

g. 1 - Control transformer of each type and rating.

h. 1 - Control relay of each type and rating.

i. 1 - Contactor auxiliary contact of each type.

n. j - One quart containers of the paint used for the exterior surfaces of outdoor equipment.

k. 4 - Keys for motor control center door lock.

PART 2 PRODUCTS

2.1 CONNECTIONS

All bolts, studs, machine screws, nuts, and tapped holes shall be in accordance with ASME B1.1. The sizes and threads of all conduit and fittings, tubing and fittings, and connecting equipment shall be in accordance with ASME B1.20.1. All ferrous fasteners shall have rust-resistant finish and all bolts and screws shall be equipped with approved locking devices. Manufacturer's standard threads and construction may be used on small items which, in the opinion of the COR, are integrally replaceable, except that threads for external connections to these items and meet the above requirements.

2.2 MOLDED CASE CIRCUIT BREAKERS

Molded case circuit breakers shall conform to the applicable requirements of UL 489. The circuit breakers shall be manually-operated, shall be quick-make, quick-break, common trip type, and shall be of automatic-trip type unless otherwise specified or indicated on the drawings. Operate all poles of each breaker simultaneously by means of a common handle. The operating handles shall clearly indicate whether the breakers are in "On," "Off," or "Tripped" position and shall have provisions for padlocking in the "Off" position. Provide personnel safety line terminal shields for each breaker. The circuit breakers shall be products of only one manufacturer, and shall be interchangeable when of the same frame size. Where indicated on the drawings, provide circuit breakers with shunt trip devices.

2.2.1 Trip Units

Except as otherwise noted, the circuit breakers, of frame sizes and the trip unit ratings as shown on the drawings, shall be provided with combination thermal and instantaneous magnetic or solid state trip units. The Government reserves the right to change the indicated trip ratings, within frame limits, of the trip devices at the time the shop drawings are submitted for approval. The breaker trip units shall be interchangeable and the instantaneous magnetic trip units shall be adjustable on frame sizes larger than 150 amperes. Nonadjustable instantaneous magnetic trip units shall be set at approximately 10 times the continuous current ratings of the circuit breakers. Solid state trip units, where indicated, shall also have adjustable long time pick-up and delay,short time pick-up and delay, and ground fault pick-up and delay.

2.2.2 480-Volt AC Circuits

Circuit breakers for 480-volt or 277/480-volt ac circuits shall be rated 600 volts ac, and shall have an UL listed minimum interrupting capacity of 65,000 symmetrical amperes at 600 volts ac.

2.3 WIRING

All control wire is to be stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44 or Type MTW meeting UL 1063, and shall pass the VW-1 flame tests included in those standards. Hinge wire shall have Class K stranding. Current transformer secondary leads shall be not smaller than No. 10 AWG. The minimum size of control wire shall be No. 14 AWG. Power wiring for 480-volt circuits and below shall be of the same type as control wiring and the minimum size shall be No. 12 AWG. Give special attention to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.4 TERMINAL BLOCKS

Control circuit terminal blocks for control wiring shall be molded or fabricated type with barriers, rated not less than 600 volts. The terminals shall be removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts. The terminals are to be no less than No. 10 in size and having sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal. The terminal arrangement is subject to the approval of the COR and not less than four (4) spare terminals or 10 percent, whichever is greater, shall be provided on each block or group of blocks. Modular, pull apart, terminal blocks will be acceptable provided they are of the channel or rail-mounted type. Submit data showing that the proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.4.1 Types of Terminal Blocks

2.4.1.1 Short-Circuiting Type

Furnish short-circuiting type terminal blocks for all current transformer secondary leads and shall have provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks shall meet the requirements of paragraph CONTROL CIRCUIT TERMINAL BLOCKS above.

2.4.1.2 Load Type

Provide load terminal blocks rated no less than 600 volts and of adequate capacity for the conductors for NEMA Size 6 and smaller motor controllers and for other power circuits except those for feeder tap units. The terminals shall be of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, screws shall have hexagonal heads. Conducting parts between connected terminals shall have adequate contact surface and cross-section to operate without overheating. Each connected terminal shall have the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.4.2 Marking Strips

Provide white or other light-colored plastic marking strips, fastened by screws to each terminal block, for wire designations. Make the wire numbers with permanent ink. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block. Marking strips shall accommodate the two sets of wire numbers. Each device to which a connection is made shall be assigned a device designation in accordance with NEMA ICS 1 and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, provide additional wire and cable designations for identification of remote (external) circuits for the Government's wire designations. Prints of drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

2.5 SPACE HEATERS

Provide space heaters where indicated on the drawings and control using an adjustable 50 to 90 degrees F thermostat, magnetic contactor, and a molded-case circuit breaker and a 480-120 volt single-phase transformer. The space heaters shall be 250-watt, 240 volt strip elements operated at 120 volts and shall be supplied from the motor control center bus wired to terminal blocks for connection to 120-volt single-phase power sources located external to the control centers. The contactors shall be open type, electrically-held, rated 30 amperes, 2-pole, with 120-volt ac coils.

2.6 MOTOR CONTROL CENTERS

Design each motor control center for operation on 480-volts ac, 3-phase, 60-Hz system, and the ensure that equipment conforms to all the applicable requirements of NEMA ICS 1, NEMA ICS 2, NEMA ICS 4, NEMA ICS 6, UL 845 and CEC. List and label vertical sections and individual units under UL 845 where ever possible. In lieu of the UL listing, certification from any nationally recognized, adequately equipped, testing agency that the individual units and vertical sections have been tested and conform to the UL requirements of that agency will be acceptable when approved by the COR. Provide NEMA Class I, Type B or C as indicated in the bid item list, motor control centers in accordance with NEMA ICS 2.

2.6.1 Enclosures

Each motor control center shall consist of the required number of vertical sections of 90 inches nominal height, bolted together, with steel channel sills and suitable for mounting against a wall. Vertical section shall be 20 inches deep and buses, control wiring, control transformers, small power transformers, terminal blocks, line terminals, cable supports, and clamps shall be accessible from the front. Enclosure shall be NEMA Type 3R. Fabricate the control centers from smooth select steel sheets shaped and reinforced to form rigid free-standing structures. Metal thickness for enclosures shall be not less than specified in NEMA ICS 6 without exception. Fabricate and bolt vertical edges of sections exposed to view so that the joints will not pass a 1/16 inch gage. Design each structure for addition of future sections required. Isolate individual compartments

from adjacent compartments. Make provisions for leveling the entire assembled motor-control center sections and bolting them together so that they form a contiguous structural enclosure.

Lifting angles shall be 7 gage, and shall be provided on the top of each section, and shall extend the entire width of the section, and shall be capable of supporting the entire weight of the motor-control center section without distortion. Provide base channels with holes to facilitate floor mounting and leveling.

2.6.1.1 Unit Compartments

Each operating unit shall contain equipment as shown on the drawings, mounted in an individual cell. The unit assembly, except main circuit breakers, panelboards and auxiliary control devices, shall be drawout type removed from the front, without rear access or disturbing other units in the control center assembly. All drawout type unit assemblies shall have positive guide rail system to ensure alignment of connection to vertical bus. Units shall be mechanically interlocked with the door to prevent removal while in the energized position. Each removable unit shall have provision for padlocking in a position in which it is disconnected from the vertical bus although not removed from the stationary structure. Provide all ventilating openings with corrosion-resistant insect-proof screens on the inside. Provide bus closing plugs for all unused openings in vertical bus barriers.

Compartments for future combination motor-control units shall be complete with hardware, buses, and hinged doors ready to receive future draw-out units. Compartments for spare combination motor-control units shall be complete with buses, hinged doors, and draw-out units but without load terminal connections. Spare spaces shall be complete with buses and screwed-on front cover plates.

2.6.1.2 Motor Control Center Doors and Covers

Provide each unit compartment, including blank compartments for future use, with either a flange-formed or a rolled-edge door. Mount each door on fully-concealed or continuous full-length piano-type hinges and provide with positive fasteners. Prevent door sag by proper alignment of hinges made of sufficiently strong material. Interlock the door fastenings to prevent opening when the equipment is energized. The external operating handle shall clearly indicate whether the equipment is in an "ON", "OFF" or "TRIPPED" position.

2.6.1.3 Horizontal Wireways

Structure shall have a minimum 12 inches high wireway at the top and a 6 inches minimum wireway at the bottom. Both horizontal wireways shall run the length of the structure Provide a master terminal block compartment with full length wireway space at the top where indicated in all Type C assemblies. Provide cover plates on the side of the assembly to permit extension of the horizontal bus and wireway when vertical sections are added.

2.6.1.4 Vertical Wireways

Provide vertical wireways in all vertical sections accepting multiple plug-in components. Vertical wireways shall connect with horizontal wireways at the top and bottom and be a minimum 4 inches wide. Provide

barriers in sections containing both ac and dc vertical buses. Provide doors on each vertical wireway. The exposed surface of any door shall not deviate more than 1/16 inch from a true plane.

2.6.1.5 Sills

Channel iron foundations, complete with bolts and drilled holes for grouting and anchoring to the floor, shall be furnished for the complete length (front and rear) of each motor control center assembly. The channels shall be designed for flat mounting and maximum channel depth shall be 1-1/2 inches. Additional channel or substantial metal trim shall be provided flush with the end panels to completely enclose the bases across the ends of the equipment assemblies.

2.6.1.6 NEMA 3R Enclosures

The motor control center shall be non-walk in NEMA Type 3R rainproof enclosure as shown on the drawings. The outside enclosure shall consist of smooth select steel sheets on a structural steel frame. Provide full-length single or double doors with top and bottom bolts and a center latch operated by means of a keyed handle. Steel sheets and doors shall be not less than No. 10 gage thick and doors shall have bent angle or channel edges with all corner seams welded and ground smooth. Assemble the motor control center within the enclosure with adequate gaskets and structure to assure a measure of vandal resistance. Ventilating openings and an effective insulating air space of approximately 2 inches shall be provided below the roof of the structure which shall slope from front to back for adequate drainage. The outside edges of the control center base shall permit easy sealing at the concrete surface with mastic compound. Furnish a 200-watt outdoor lighting fixture with globe and guard to light the front of the assembly. All lighting connections shall be watertight. Furnish a weatherproof switch installation on the front or side of the enclosure so that the light can be switched prior to opening the assembly doors. The exterior manual switch shall be "ac" rated, 15 amperes, 120/277 volts. Provide two duplex receptacle units within the outer weatherproof enclosure. Wire the lighting fixture and receptacles to the 120-volt ac panelboard located in the control center, and run external wiring in rigid galvanized steel conduit.

2.6.1.7 Shutters

Drawout units shall have shutters which close when the unit is withdrawn to isolate the vertical bus.

2.6.2 Buses

All buses shall be of tinned copper and all bolted splices and connections between buses and for extensions or taps for equipment shall be tin or silver-plated. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B 187/B 187M. All splices for field assembly shall be bolted with at least two bolts and shall employ the use of "Belleville" washers in the connection. The bus ratings shall be based on a 65 degree Celsius maximum temperature rise in accordance with UL 845 requirements. Bus shall have a short-circuit current rating of not less than 65,000 RMS symmetrical amperes. Support all bus work on wet process porcelain insulators, glass polyester, or suitable molded material.

2.6.2.1 Horizontal Bus

Provide each control center assembly with a three-phase main horizontal bus, with a continuous current rating not less than 1,200 amperes, located across the top of each vertical section. Drill the ends of horizontal buses for future extensions. Fully insulate the main horizontal bus.

2.6.2.2 Vertical Bus

Provide each vertical section with a three-phase vertical bus with a continuous current rating of 600 amperes connected to the horizontal bus by brazing, welding, or bolting. Where the incoming feeder breakers are located at the bottom of a control center, rate the vertical bus in that section the same as the main horizontal bus. Extend vertical buses from the horizontal bus to the bottom of the lowest available unit mounting space. Isolate the vertical bus from wireways and equipment in compartments.

2.6.2.3 Ground Bus

Provide a tin-plated copper ground bus full width at the bottom of the motor control center line-up. Provide a full clamp-type solderless copper or copper alloy lug for No. 2/0 AWG stranded copper cable at each end of the bus for connection to the station grounding system. Ground bus shall be capable of carrying the rated short-circuit current available in the motor-control center.

2.6.3 Combination Starters

Combination motor controller units shall contain motor circuit protectors molded-case circuit breakers, auxiliary and pilot devices and a magnetic contactor with thermal overload relays and reduced voltage starter where indicated on the drawings. The ratings of motor circuit protectors, air circuit breakers, contactors, motor controllers and other devices shall be as shown on the drawings. All combination motor controller units shall have short circuit ratings equal to 65,000 or greater. Where control push-buttons, indicating lamps, "Hand-Off-Automatic" switches, and similar control devices are associated with a unit, mount them on the unit compartment door. Door-mounted components shall not interfere with access within the compartments. Molded case circuit breakers for use in combination starters shall meet the requirements of paragraph entitled, "Molded Case Circuit Breakers," of this section. Motor circuit protectors shall be only part of the combination starters as required by CEC and shall conform to all requirements of paragraph entitled, "Molded Case Circuit Breakers," of this section except that trip units shall have provision for locking the selected trip setting.

2.6.3.1 Magnetic Contactors

Magnetic contactors shall be of the NEMA sizes indicated on the drawings. The rating, performance and service characteristics shall conform to the requirements of NEMA ICS 2 for contactors with continuous current ratings for the duty indicated. Contactors for motor control shall be rated for full-voltage starting (Class A controllers). Contactors shall be suitable for at least 200,000 complete operations under rated load without more than routine maintenance. Minimize the interruption arc and flame by suitable arc chutes or other means so that no damage will be done to other portions of the device. The arc chutes, if provided, shall be easily removable without removing or dismantling other parts. The contacts shall be easily

removable. All current-carrying contact surfaces shall be silver-surfaced or of other approved material to prevent the formation of high resistance oxides. The contactor shall operate without chatter or perceptible hum while energized. Coils shall be suitable for continuous operation 480-volt ac circuits. Alternating-current contactors shall be three-pole, except where otherwise noted, and shall be insulated for 600 volts ac and of the electrically- operated, magnetically-held type. Direct-current contactors shall be two-pole, suitable for controlling circuits operating at 125 volts dc, insulated for 250 volts dc, electrically-operated, magnetically-held type and adequate for full-voltage motor starting service.

2.6.3.2 Reduced Voltage Starters

Autotransformers shall be rated for medium duty and have taps according to NEMA ICS 2. For thermal over load protection, the autotransformer shall have normally closed thermostat wired in series with the normally closed thermal overload contact of the starter. Initial connection shall be to the 65 percent tap. Solid State soft-start starters shall be three phase SCR controlled for stepless reduced voltage starting of induction motors. Current transformers shall provide feedback signal to regulate torque during start up and to prevent overload conditions while motor is running. Starter shall have starting current of 300 percent of full load amps for thirty seconds, bypass/isolation contactor, and three phase thermal overload relay.

2.6.3.3 Auxiliary Contacts

Each controller shall be provided with a minimum of three auxiliary contacts which can be easily changed from normally open to normally closed. Where indicated on the drawings, provide a fourth auxiliary contact and red and green indicating lights.

2.6.3.4 Overload Relays

Except as otherwise indicated, each controller shall be provided three NEMA Class 20 thermal overload relays with external manual reset. Prior to shipment of the control centers, the COR will furnish the ratings of the heater elements to be installed in the relays by the Contractor.

2.6.3.5 Voltage Fault Protection

Where shown, provide starters with protection against voltage faults, phase unbalance, phase loss, phase reversal, undervoltage and overvoltage. Upon sensing one of these faults, the protector shall de-energize the starter. The protector shall use a combination of voltage and phase-angle sensing to detect phase loss even when regenerated voltages are present. Connect the protector to the load side of the motor circuit disconnect. The protector shall have an adjustable line voltage trip level, adjustable trip delay, automatic reset and manual reset by an external normally closed push-button, and Double Pull Double Throw (DPDT) output contacts. Protector operation shall have repeatability of +1 percent of set point, maximum, and a dead band of 2 percent maximum. Protector shall have green indicator to show normal status and red indicator to show tripped status. Indicators will be visible through the compartment door, when LED's are used cover the protector with a clear unbreakable cover, when lamps are used they shall have nameplates and be grouped with other indicating lights.

2.6.3.6 Control Circuit Disconnects

Disconnect control circuit power when the unit compartment is opened.

2.6.4 Molded Case Circuit Breakers in Unit Compartments

Molded case circuit breakers for installation in unit compartments shall meet the requirements of paragraph entitled, "Molded Case Circuit Breakers," of this section.

2.6.5 Panelboards for Motor Control Centers

Panelboards shall meet the requirements of Section 26 24 16.00 40 PANELBOARDS.

2.6.6 Wiring for Motor Control Centers

All wiring shall meet the requirements of paragraph entitled, "Wiring," of this section. Provide heavy-duty clamp type terminals for terminating all power cables entering the control centers.

2.6.6.1 Contractor's Wiring

Form wiring into groups, suitably bound together, properly supported and run straight horizontally or vertically. There shall be no splices in the wiring. The manufacturer's standard pressure-type wire terminations for connections to internal devices will be acceptable. Add terminal blocks for wiring to devices having leads instead of terminals. Use ring tongue indented terminals on all wires terminated on control terminal blocks for external or interpanel connections and at shipping splits. All stud terminals shall have contact nuts and either locking nuts or lockwashers.

2.6.6.2 External Connections

Power and control cables will enter the control centers at the bottom where shown on the drawings. Where power and control entry points are not shown, and terminal blocks are not given on the drawings, the Government will furnish this information to the Contractor after award of contract.

2.6.6.3 Terminal Blocks

Terminal blocks shall meet the requirements of paragraph TERMINAL BLOCKS above. In no case shall the terminals provided for circuit breakers or contactors accommodate less than the number or size of conductors shown on the drawings. Give special attention to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.6.7 Control Transformers

Mount control transformers for several starter units in a separate compartment and connect its primary windings to the main bus through a molded case circuit breaker of suitable rating. The control transformers shall be rated 480-120 volts and shall conform to the requirements for control transformers in NEMA ST 1. Control transformers shall have adequate volt-ampere capacity for the control functions indicated and an additional 10 percent capacity. Install transformers without primary fuses. Except as otherwise indicated on the drawings, each unit compartment shall provide a fuse for control power in one secondary lead

and shall have the other secondary lead grounded. The unit disconnect shall be equipped with a normally open contact to isolate the control circuit from the source when the controller disconnect is open.

2.6.8 Accessories and Control Devices

Control accessories shall be provided, and shall be suitable for mounting on the front of, or inside, the control centers as indicated on the drawings. Control accessories shall meet the applicable requirements of NEMA ICS 2. Mount relays and other equipment that mechanical vibration will not cause false operation.

2.6.8.1 Control Stations

Push-button stations and selector switches shall conform to NEMA ICS 2, shall be of the heavy-duty, oil-tight type, rated 600 volts ac, and have a contact rating designation of A600. Provide switches with escutcheon plates clearly marked to show operating positions. Provide sufficient contact blocks to make up the electrically separate contacts required for lead-lag selector switches.

2.6.8.2 LED Indicating Lights

Furnish red and green LED's where shown on the drawings, indicating contact "open" and "closed" position. The LED's shall be accessible and replaceable from the front of the control center through a finished opening in the compartment door. The LED assemblies shall be of the heavy duty oiltight, watertight, and dusttight type.

2.6.8.3 Control Relays

Control relays shall be of the electrically operated, magnetically held, self-reset, open type, suitable for mounting inside the starter compartments, and shall be 120-volt ac. Contacts shall be as indicated on the drawings and shall have a contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2.

2.6.8.4 Timing Relays

Timers shall be pneumatic type. They shall be suitable for mounting inside the control center and shall be rated 120 volts ac, 60 Hz. Provide instantaneous and time delay contacts as indicated on the drawings, and have a contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2. Provide means for manual adjustment over a range as indicated on the drawings.

2.6.8.5 Alternators

Alternators 120-volt, 60 Hz, single-phase, open type, suitable for mounting inside of control center as indicated. Alternators shall automatically cycle two motor starters in such a manner that No. 1 will lead and No. 2 will lag during the first cycle, and during the second cycle No. 2 will lead and No. 1 will lag, and the third cycle will repeat the first cycle. The duration of a cycle will be determined by an adjustable time delay. Contacts shall have a minimum contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2.

2.6.8.6 Elapsed-Time Meters

Hour-indicating time meters shall have 6- digit registers with counter numbers at least 1/4 inch high. White numbers on black backgrounds shall provide hour indication with the last digit in contrasting colors to indicate tenths of an hour. The enclosure shall be 3-1/2 inches square and dust resistant. Operating voltage shall be 120 volts ac. They shall be of the nonreset type.

2.6.9 Feeder Tap Units

Provide feeder tap units as indicated on the drawings. Feeder tap units shall include externally operable molded-case circuit breakers in combination motor-control unit enclosures for the protection of non-motor loads or remotely located magnetic motor-controllers. Not more than two molded-case circuit breakers shall be contained in feeder tap units.

2.6.10 Metering Section

2.6.10.1 Instrument Transformers

All transformers used for metering shall meet the requirements of NEMA/ANSI C12.11 and IEEE C57.13. Protect voltage transformers with removable primary and secondary fuses. Install fuses in each ungrounded lead and located adjacent to the transformers in an easily accessible place. If cable connections to current transformer primary are required, furnish terminals of an approved solderless type and proper size. If current transformers are connected to buses, furnish proper connections, complete with bolts, nuts, washers and other accessories.

2.7 PAINTING

Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Prime exterior surfaces, fill where necessary, and give no less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray, and equipment located outdoors shall be ANSI Light Grey. All touch-up work shall be done with manufacturer's coatings as supplied under paragraph entitled, "Spare Parts," of this section.

2.8 FACTORY TESTS

Each item of equipment supplied under this contract shall be given the manufacturer's routine factory tests and tests as specified below, to insure successful operation of all parts of the assemblies. All tests required herein shall be witnessed by the COR unless waived in writing, and no equipment shall be shipped until it has been approved for shipment by the COR. Notify the COR a minimum of 14 days prior to the proposed date of the tests so that arrangements can be made for the COR to be present at the tests. The factory test equipment and the test methods used shall conform to the applicable NEMA Standards, and shall be subject to the approval of the COR. Reports of all witnessed tests shall be signed by witnessing representatives of the Contractor and COR. Bear the cost of performing all tests and include in the prices bid in the schedule for equipment.

2.8.1 Motor Control Centers Tests

2.8.1.1 Dielectric Tests

Each motor control center shall be completely assembled and given dielectric tests in accordance with NEMA ICS 1.

2.8.1.2 Operational Tests

The correctness of operation of each air circuit breaker or motor circuit protector and magnetic contactor and of all control devices, accessories and indicating lamps, shall be checked. These checks shall be made at rated voltage with power supplies to the main buses. All magnetic contactors shall also be checked for proper operation with power at 90 percent of rated voltage.

2.8.1.3 Short Circuit Tests

If the unit is not UL labeled for the specified short circuit, the Contractor may submit design tests demonstrating that satisfactory short-circuit tests, as specified in NEMA ICS 2, have been made on a motor control center of similar type of construction and having the same available short circuit current at the motor terminals, including any motor contributions, as the motor control centers specified to be furnished under these specifications.

PART 3 EXECUTION

3.1 INSTALLATION

Complete assembly shall be electrically and mechanically connected and assembled from coordinated subassemblies shipped in complete sections from the manufacturer. Installation shall be aligned, leveled, and secured to the supporting construction in accordance with the manufacturer's recommendations.

3.2 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Motor-control centers shall be subjected to continuity and insulation tests after the installation has been completed and before the motor-control center is energized.

Provide test equipment, labor, and personnel to perform the tests required. Conduct continuity tests using a dc device with bell or buzzer.

Motor-control centers shall be completely isolated from extraneous electrical connections. Substation feeder breakers, circuit breakers in switchboards, and other disconnecting devices shall be used to isolate the motor-control center under test.

Conduct insulation tests on 600-volt motor-control centers using a 1,000-volt insulation-resistance test set. Record readings every 15 seconds for the first minute and every minute thereafter for 10 minutes. Resistance between phase conductors and between phase conductors and ground shall be not less than 50 megohms.

Conduct insulation tests on motor-control centers 480 volts or less using a 500-volt insulation-resistance test set. Record readings every 15 seconds for the first minute and every minute thereafter for 10 minutes. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Prior to final acceptance the motor control center shall be energized and loaded (to the maximum load possible, but not less than 10 percent of expected full load)for a minimum of 10 minutes and the temperature measured, with a non-contact device, to verify connection integrity. The temperature detector shall be accurate within 0.5 degrees C. Each phase temperature of 3 phase circuits and individual connections compared to other similarly loaded connections shall be within 3 degrees C of each other. Temperatures outside these values warrant investigation.

Conduct phase-rotation tests on all three-phase circuits using a phase-rotation indicating instrument. Phase rotation of electrical connections to motors and other connected equipment shall be clockwise.

Record test data and include location and identification of motor-control centers and megohm readings versus time.

Final acceptance shall depend upon the satisfactory performance of the motor-control centers under test. No motor-control center shall be energized until recorded test data have been approved by the COR. Provide final test reports to the COR. Reports shall have a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

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SECTION 26 29 23

VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS

PART 1 GENERAL

1.1 SUMMARY

This section covers variable frequency drive for motors rated up to 575 volts, for use on electric power systems of 600 volts or less, 50/60 hertz.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 519	Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
IEEE C62.41.1	Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	Standard for Industrial Control and Systems: General Requirements
NEMA ICS 3.1	Guide for the Application, Handling, Storage, Installation and Maintenance of Medium-Voltage AC Contactors, Controllers and Control Centers
NEMA ICS 6	Enclosures
NEMA ICS 7	Adjustable-Speed Drives

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-461	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 508C	Power Conversion Equipment

1.3 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies apply to this section with additions and modifications specified herein.

1.4 SYSTEM DESCRIPTION

1.4.1 Performance Requirements

1.4.1.1 Electromagnetic Interference Suppression

Computing devices, as defined by 47 CFR 15, MIL-STD-461 rules and regulations, shall be certified to comply with the requirements for class A computing devices and labeled as set forth in part 15.

1.4.1.2 Electromechanical and Electrical Components

Electrical and electromechanical components of the Variable Frequency Drive (VFD) shall not cause electromagnetic interference to adjacent electrical or electromechanical equipment while in operation.

1.4.2 Electrical Requirements

1.4.2.1 Power Line Surge Protection

IEEE C62.41.1 and IEEE C62.41.2, IEEE 519 Control panel shall have surge protection, included within the panel to protect the unit from damaging transient voltage surges. Surge arrestor shall be mounted near the incoming power source and properly wired to all three phases and ground. Fuses shall not be used for surge protection.

1.4.2.2 Sensor and Control Wiring Surge Protection

I/O functions as specified shall be protected against surges induced on control and sensor wiring installed outdoors and as shown. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Schematic diagrams

Interconnecting diagrams

Installation drawings

Submit drawings for government approval prior to equipment construction or integration. Modifications to original drawings made during installation shall be immediately recorded for inclusion into the as-built drawings.

SD-03 Product Data

Variable frequency drives

Wires and cables

Equipment schedule

Include data indicating compatibility with motors being driven.

SD-06 Test Reports

VFD Test

Performance Verification Tests

Endurance Test

SD-08 Manufacturer's Instructions

Installation instructions

SD-09 Manufacturer's Field Reports

VFD Factory Test Plan

Factory test results

SD-10 Operation and Maintenance Data

Variable frequency drives, Data Package 4

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Provide service and maintenance information including preventive maintenance, assembly, and disassembly

procedures. Include electrical drawings from electrical general sections. Submit additional information necessary to provide complete operation, repair, and maintenance information, detailed to the smallest replaceable unit. Include copies of as-built submittals. Provide routine preventative maintenance instructions, and equipment required. Provide instructions on how to modify program settings, and modify the control program. Provide instructions on drive adjustment, trouble-shooting, and configuration. Provide instructions on process tuning and system calibration.

1.6 QUALITY ASSURANCE

1.6.1 Schematic Diagrams

Show circuits and device elements for each replaceable module. Schematic diagrams of printed circuit boards are permitted to group functional assemblies as devices, provided that sufficient information is provided for government maintenance personnel to verify proper operation of the functional assemblies.

1.6.2 Interconnecting Diagrams

Show interconnections between equipment assemblies, and external interfaces, including power and signal conductors. Include for enclosures and external devices.

1.6.3 Installation Drawings

Show floor plan of each site, with V.F.D.'s and motors indicated. Indicate ventilation requirements, adequate clearances, and cable routes.

1.6.4 Equipment Schedule

Provide schedule of equipment supplied. Schedule shall provide a cross reference between manufacturer data and identifiers indicated in shop drawings. Schedule shall include the total quantity of each item of equipment supplied. For complete assemblies, such as VFD's, provide the serial numbers of each assembly, and a sub-schedule of components within the assembly. Provide recommended spare parts listing for each assembly or component.

1.6.5 Installation instructions

Provide installation instructions issued by the manufacturer of the equipment, including notes and recommendations, prior to shipment to the site. Provide operation instructions prior to acceptance testing.

1.6.6 Factory Test Results

Document test results and submit to government within 7 working days after completion of test.

1.7 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.8 WARRANTY

The complete system shall be warranted by the manufacturer for a period of one year, or the contracted period of any extended warrantee agreed upon by the contractor and the Government, after successful completion of the acceptance test. Any component failing to perform its function as specified and documented shall be repaired or replaced by the contractor at no additional cost to the Government. Items repaired or replaced shall be warranted for an additional period of at least one year from the date that it becomes functional again, as specified in the FAR CLAUSE 52.246-21.

1.9 MAINTENANCE

1.9.1 Spare Parts

Manufacturers provide spare parts in accordance with recommended spare parts list.

1.9.2 Maintenance Support

During the warranty period, the Contractor shall provide on-site, on-call maintenance services by Contractor's personnel on the following basis: The service shall be on a per-call basis with 36 hour response. Contractor shall support the maintenance of all hardware and software of the system. Various personnel of different expertise shall be sent on-site depending on the nature of the maintenance service required. Costs shall include travel, local transportation, living expenses, and labor rates of the service personnel while responding to the service request. The provisions of this Section are not in lieu of, nor relieve the Contractor of, warranty responsibilities covered in this specification. Should the result of the service request be the uncovering of a system defect covered under the warranty provisions, all costs for the call, including the labor necessary to identify the defect, shall be borne by the Contractor.

PART 2 PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES (VFD)

Provide frequency drive to control the speed of induction motor(s). The VFD shall include the following minimum functions, features and ratings.

a. Input circuit breaker per UL 489 with a minimum of 10,000 amps symmetrical interrupting capacity and door interlocked external operator.

b. A converter stage per UL 508C shall change fixed voltage, fixed frequency, ac line power to a fixed dc voltage. The converter shall utilize a full wave bridge design incorporating diode rectifiers. Silicon Controlled Rectifiers (SCR) are not acceptable. The converter shall be insensitive to three phase rotation of the ac line and shall not cause displacement power factor of less than .95 lagging under any speed and load condition.

c. An inverter stage shall change fixed dc voltage to variable frequency, variable voltage, ac for application to a standard NEMA design B squirrel cage motor. The inverter shall be switched in a manner to produce a sine coded pulse width modulated (PWM) output waveform.

d. The VFD shall be capable of supplying 120 percent of rated full load

current for one minute at maximum ambient temperature.

e. The VFD shall be designed to operate from a 480 volt, plus or minus 10 percent, three phase, 60 Hz supply, and control motors with a corresponding voltage rating.

f. Acceleration and deceleration time shall be independently adjustable from one second to 60 seconds.

g. Adjustable full-time current limiting shall limit the current to a preset value which shall not exceed 120 percent of the controller rated current. The current limiting action shall maintain the V/Hz ratio constant so that variable torque can be maintained. Short time starting override shall allow starting current to reach 175 percent of controller rated current to maximum starting torque.

h. The controllers shall be capable of producing an output frequency over the range of 3 Hz to 60 Hz (20 to one speed range), without low speed cogging. Over frequency protection shall be included such that a failure in the controller electronic circuitry shall not cause frequency to exceed 110 percent of the maximum controller output frequency selected.

i. Minimum and maximum output frequency shall be adjustable over the following ranges: 1) Minimum frequency 3 Hz to 50 percent of maximum selected frequency; 2) Maximum frequency 40 Hz to 60 Hz.

j. The controller efficiency at any speed shall not be less than 96 percent.

k. The controllers shall be capable of being restarted into a motor coasting in the forward direction without tripping.

l. Protection of power semiconductor components shall be accomplished without the use of fast acting semiconductor output fuses. Subjecting the controllers to any of the following conditions shall not result in component failure or the need for fuse replacement:

1. Short circuit at controller output

2. Ground fault at controller output

3. Open circuit at controller output

4. Input undervoltage

5. Input overvoltage

6. Loss of input phase

7. AC line switching transients

8. Instantaneous overload

9. Sustained overload exceeding 115 percent of controller rated current

10. Over temperature

11. Phase reversal

m. Solid state motor overload protection shall be included such that current exceeding an adjustable threshold shall activate a 60 second timing circuit. Should current remain above the threshold continuously for the timing period, the controller will automatically shut down.

n. A slip compensation circuit shall be included which will sense changing motor load conditions and adjust output frequency to provide speed regulation of NEMA B motors to within plus or minus 0.5 percent of maximum speed without the necessity of a tachometer generator.

o. The VFD shall be factory set for manual restart after the first protective circuit trip for malfunction (overcurrent,undervoltage, overvoltage or overtemperature) or an interruption of power. The VFD shall be capable of being set for automatic restart after a selected time delay. If the drive faults again within a specified time period (adjustable 0-60 seconds), a manual restart will be required.

p. The VFD shall include external fault reset capability. All the necessary logic to accept an external fault reset contact shall be included.

q. Provide critical speed lockout circuitry to prevent operating at frequencies with critical harmonics that cause resonant vibrations. The VFD shall have a minimum of three user selectable bandwidths.

r. Provide the following operator control and monitoring devices mounted on the front panel of the VFD:

1. Manual speed potentiometer.

2. Hand-Off-Auto (HOA) switch.

3. Power on light.

4. Drive run power light.

5. Local display.

s. Provide properly sized NEMA rated by-pass and isolation contactors to enable operation of motor in the event of VFD failure. Mechanical and electrical interlocks shall be installed between the by-pass and isolation contactors. Provide a selector switch and transfer delay timer.

2.2 ENCLOSURES

Provide equipment enclosures conforming to NEMA 250, NEMA ICS 7, NEMA ICS 6.

2.3 WIRES AND CABLES

All wires and cables shall conform to NEMA 250, NEMA ICS 7, CEC.

2.4 NAMEPLATES

Nameplates external to NEMA enclosures shall conform with the requirements of Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS. Nameplates internal to enclosures shall be manufacturer's standard, with

the exception that they must be permanent.

2.5 SOURCE QUALITY CONTROL

2.5.1 VFD Factory Test Plan

To ensure quality, each VFD shall be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. Provide test plans and test reports.

PART 3 EXECUTION

3.1 INSTALLATION

Per NEMA ICS 3.1, install equipment in accordance with the approved manufacturer's printed installation drawings, instructions, wiring diagrams, and as indicated on project drawings and the approved shop drawings. A field representative of the drive manufacturer shall supervise the installation of all equipment, and wiring.

3.2 FIELD QUALITY CONTROL

Specified products shall be tested as a system for conformance to specification requirements prior to scheduling the acceptance tests. Contractor shall conduct performance verification tests in the presence of Government representative, observing and documenting complete compliance of the system to the specifications. Contractor shall submit a signed copy of the test results, certifying proper system operation before scheduling tests.

3.2.1 VFD Test

A proposed test plan shall be submitted to the COR at least 28 calendar days prior to proposed testing for approval. The tests shall conform to NEMA ICS 1, NEMA ICS 7, and all manufacturer's safety regulations. The Government reserves the right to witness all tests and review any documentation. The contractor shall inform the Government at least 14 working days prior to the dates of testing. Contractor shall provide video tapes, if available, of all training provided to the Government for subsequent use in training new personnel. All training aids, texts, and expendable support material for a self-sufficient presentation shall be provided, the amount of which to be determined by the COR.

3.2.2 Performance Verification Tests

"Performance Verification Test" plan shall provide the step by step procedure required to establish formal verification of the performance of the VFD. Compliance with the specification requirements shall be verified by inspections, review of critical data, demonstrations, and tests. The Government reserves the right to witness all tests, review data, and request other such additional inspections and repeat tests as necessary to ensure that the system and provided services conform to the stated requirements. The contractor shall inform the Government 14 calendar days prior to the date the test is to be conducted.

3.2.3 Endurance Test

Immediately upon completion of the performance verification test, the endurance test shall commence. The system shall be operated at varying

rates for not less than 192 consecutive hours, at an average effectiveness level of .9998, to demonstrate proper functioning of the complete PCS. Continue the test on a day-to-day basis until performance standard is met. During the endurance test, the contractor shall not be allowed in the building. The system shall respond as designed.

3.3 DEMONSTRATION

3.3.1 Training

Coordinate training requirements with the COR.

3.3.1.1 Instructions to Government Personnel

Provide the services of competent instructors who will give full instruction to designated personnel in operation, maintenance, calibration, configuration, and programming of the complete control system. Orient the training specifically to the system installed. Instructors shall be thoroughly familiar with the subject matter they are to teach. The Government personnel designated to attend the training will have a high school education or equivalent. The number of training days of instruction furnished shall be as specified. A training day is defined as eight hours of instruction, including two 15-minute breaks and excluding lunch time; Monday through Friday. Provide a training manual for each student at each training phase which describes in detail the material included in each training program. Provide one additional copy for archiving. Provide equipment and materials required for classroom training. Provide a list of additional related courses, and offers, noting any courses recommended. List each training course individually by name, including duration, approximate cost per person, and location of course. Unused copies of training manuals shall be turned over to the Government at the end of last training session.

3.3.1.2 Operating Personnel Training Program

Provide one 2 hour training session at the site at a time and place mutually agreeable between the Contractor and the Government. Provide session to train 4 operation personnel in the functional operations of the system and the procedures that personnel will follow in system operation. This training shall include:

a. System overview

b. General theory of operation

c. System operation

d. Alarm formats

e. Failure recovery procedures

f. Troubleshooting

3.3.1.3 Engineering/Maintenance Personnel Training

Accomplish the training program as specified. Training shall be conducted on site at a location designated by the Government. Provide a one day training session to train 4 engineering personnel in the functional operations of the system. This training shall include:

a. System overview

b. General theory of operation

c. System operation

d. System configuration

e. Alarm formats

f. Failure recovery procedures

g. Troubleshooting and repair

h. Maintenance and calibration

i. System programming and configuration

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SECTION 26 41 00.00 20

LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

This section covers lightning protection systems for nonordnance naval facilities.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 780	Standard for the Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 467	Grounding and Bonding Equipment
UL 96	Standard for Lightning Protection Components
UL 96A	Standard for Installation Requirements for Lightning Protection Systems
UL Electrical Construction	(2009) Electrical Construction Equipment Directory

1.3 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

1.3.1 Verification of Dimensions

Contractor shall become familiar with all details of work, verify all dimensions in field, and shall advise COR of any discrepancy before performing work. No departures shall be made without prior approval of COR.

1.3.2 System Requirements

Materials shall consist of standard products of a manufacturer regularly engaged in production of lightning protection systems and shall be manufacturer's latest UL approved design. Lightning protection system shall conform to CEC, NFPA 780, UL 96 and UL 96A.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Overall lightning protection system

Each major component

SD-06 Test Reports

Grounding system test

Lightning protection system inspection

SD-07 Certificates

UL listing or label

1.5 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean COR.

1.5.1 Installation Drawings

a. Submit installation shop drawing for the overall lightning protection system. Drawings shall include physical layout of the equipment, mounting details, relationship to other parts of the work, and wiring diagram.

b. Submit detail drawings for each major component to include manufacturer's descriptive and technical literature, catalog cuts, and installation instructions.

1.5.2 UL Listing or Label

Submit proof of compliance. Label of or listing in UL Electrical Construct ion is acceptable evidence. In lieu of label or listing, submit written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that items have been tested and conform to requirements and testing methods of Underwriters Laboratories.

1.6 SITE CONDITIONS

Contractor will become familiar with details of the work, verify dimensions in the field, and advise COR of discrepancies before performing work. Deviations from contract drawings will not be made without prior approval of COR.

PART 2 PRODUCTS

2.1 MATERIALS

Do not use a combination of materials that forms an electrolytic couple of such nature that corrosion is accelerated in presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, provide conductors with protective coatings or oversize conductors. Where mechanical hazard is involved, increase conductor size to compensate for hazard or protect conductors by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is provided, electrically bond conductor to conduit or tubing at the upper and lower ends by clamp type connectors or welds (including exothermic).

2.1.1 Main and Bonding Conductors

NFPA 780 and UL 96 Class I, Class II, or Class II modified materials as applicable.

2.1.2 Copper

Provide copper conductors on nonmetallic stacks that do not weigh less than 319 pounds per thousand feet, and provide cable such that the size of any strand in the cable is not less than No. 15 AWG. Provide thickness of web or ribbon on stacks that is not less than No. 12 AWG. Provide loop conductors that are comprised of copper conductors not smaller than No. 1/0 AWG.

2.2 COMPONENTS

2.2.1 Air Terminals

Provide terminals in accordance with UL 96, except provide Class II for Class I and Class II applications. Support air terminals more than 24 inches in length by suitable brace, with guides, not less than one-half the height of the terminal.

2.2.2 Ground Rods

Provide ground rods made of copper-clad steel conforming to conform to UL 467. Provide ground rods that are not less than 3/4 inch in diameter and 10 feet in length. Do not mix ground rods of copper-clad steel, stainless steel, galvanized ferrous, or solid copper on the job.

2.2.3 Grounding Plates

Provide grounding plates made of copper-clad steel conforming to UL 96.

2.2.4 Connections and Terminations

Provide connectors for splicing conductors that conform to UL 96, class as applicable. Conductor connections can be made by clamps or welds (including exothermic). Provide style and size connectors required for the installation.

2.2.5 Connector Fittings

Provide connector fittings for "end-to-end", "Tee", or "Y" splices that conform to NFPA 780.

2.2.6 Lightning Protection Components

Provide bonding plates, air terminal supports, chimney bands, clips, and fasteners that conform to UL 96 classes as applicable.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

Lightning protection system consists of air terminals, roof conductors, down conductors, ground connections, grounding electrodes and ground loop conductor. Electrically interconnect lightning protection system to form the shortest distance to ground. Do not use nonconducting parts of the structure as part of the building's lightning protection system. Expose conductors on the structures except where conductors are required to be in protective sleeves. Interconnect secondary conductors with grounded metallic parts within the building. Make interconnections within side-flash distances at or above the level of the grounded metallic parts.

3.1.1 Air Terminals

Air terminal design and support conforming to NFPA 780. Rigidly connect terminals to, and make electrically continuous with, roof conductors by means of pressure connectors or crimped joints of T-shaped malleable metal. Provide pressure connector or crimped joint with a dowel or threaded fitting to connect ground rod conductor with air terminal. Set air terminals at ends of structures not more than 2 feetfrom ends of ridges and corners of roofs. Do not exceed 25 feet in spacing of 2 foot high air terminals on ridges, parapets, and around perimeter of building with flat roofs. When necessary to exceed this spacing, increase specified height of air terminals not less than 2 inches for each one foot of increase over 25 feet. On large flat, or gently sloping roofs, as defined in NFPA 780, place air terminals at points of the intersection of imaginary lines dividing the surface into rectangles having sides not exceeding 50 feet in length. Secure air terminals against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces which are permanently and rigidly attached to the building or structure. Metal projections and metal parts of buildings such as smokestacks and other metal objects that are at least 3/16 inch thick and that do not contain hazardous materials, need not be provided with air terminals.

3.1.2 Roof Conductors

Connect roof conductors directly to the roof or ridge roll. Avoid sharp bends or turns in conductors. Do not make turns of less than 8 inches. Preserve horizontal or downward course on conductors. Rigidly fasten

conductors every 3 feet along the roof and down the building to the ground. Rigidly connect metal ventilators to the roof conductor at three places. Make connections electrically continuous. Course roof conductors along contours of flat roofs, ridges, parapets, and edges; and where necessary, over flat surfaces, in such a way as to join each air terminal to all the rest. Connect roof conductors surrounding tank tops, decks, flat surfaces, and flat roofs to form a closed loop.

3.1.3 Down Conductors

Make down conductors electrically continuous from air terminals and roof conductors to grounding electrodes. Course down conductors over outer extreme portions of the building, such as corners, with consideration given to location of ground connections and air terminals. Provide each building or structure not less than two down conductors located as widely separated as practicable, such as at diagonally opposite corners. Rectangular structures having gable, hip, or gambrel roofs more than 110 feet long, provide at least one additional down conductor for each additional 50 feet of length or fraction thereof. Structures exceeding 50 feet in height, provide at least one additional down conductor for each additional 60 feet of height or fraction thereof, except that this application will not cause down conductors to be placed about the perimeter of the structure at intervals of less than 50 feet. Install additional down conductors when necessary to avoid "dead ends" or branch conductors exceeding 16 feet in length, ending at air terminals. Equally and symmetrically spaced down conductors about the perimeter of the structure. Protect conductors where necessary, to prevent physical damage or displacement to the conductor.

3.1.4 Interconnection of Metallic Parts

Connect metal doors, windows, and gutters directly to ground or down conductors using not smaller than No. 6 copper conductor, or equivalent. Where there is probability of unusual wear, mechanical injury, or corrosion, provide conductors with greater electrical capacity than normal or protect the conductor. Provide mechanical ties or pressure connectors between grounds and metal doors and windows.

3.1.5 Ground Connections

Securely connect conductor forming continuations of down conductors from structure to grounding electrode in a manner to ensure electrical continuity between the two. Provide clamp type connections or welds (including exothermic) for continuation. Provide a ground connection for each down conductor. Attach down conductors to ground rods by welding (including exothermic), brazing, or clamping. Provide clamps suitable for direct burial. Protect ground connection from mechanical injury. Bond metal water pipes and other large underground metallic objects together with all grounding mediums. In making ground connections, take advantage of all permanently moist places where practicable, although avoid such places when area is wet with waste water that contains chemical substances, especially those corrosive to metal.

3.1.6 Grounding Electrodes

Provide grounding electrode for each down conductor. Extend driven ground rods into the existing undisturbed earth for a distance of not less 10 feet. Set ground rods not less than 2 feet nor more than 10 feet, from the structure. After the completed installation, measure the total resistance to ground using the fall-of-potential method described in IEEE 81. Maximum

resistance of a driven ground rod shall be 10 ohms, under normally dry conditions when a ground loop is not used. Use a ground loop when two of any three ground rods, driven not less than 10 feet into the ground, a minimum of 10 feet apart, and equally spaced around the perimeter, give a combined value exceeding 50 ohms immediately after having driven. For ground loop, provide continuous No. 1/0 bare stranded copper cable or equivalent material having suitable resistance to corrosion. Lay ground loop around the perimeter of the structure in a trench not less than 30 inches below grade, at a distance not less than 2 feet nor more than 10 feet from the nearest point of the structure. Install a ground loop in earth undisturbed by excavation, not earth fill, and do not locate beneath roof overhang, or wholly under paved areas or roadways where rainfall cannot penetrate to keep soil moist in the vicinity of the cable. Make connections between ground conductors and grounds or ground loop, and between ground loop and grounds electrically continuous.

3.1.7 Grounding Plates

Provide a grounding plate for down conductor. Set grounding plates not less than 2 feet nor more than 10 feet, from the structure. Grounding plate is to be buried as deeply in the existing dirt as local conditions allow, without exceeding 10 feetin depth.

3.2 APPLICATIONS

3.2.1 Nonmetallic Exterior Walls with Metallic Roof

Bond metal roof sections together which are insulated from each other so that they are electrically continuous. Connect air terminals so that they are electrically continuous with the metal roof as well as the roof conductors and down conductors. Bond ridge cables and roof conductors to the roof at upper and lower edges of roof and at intervals not to exceed 100 feet. Bond down conductors to roof conductors and to lower edge of metal roof. Where metal of roof is in small sections, make connections between air terminals and down conductors to at least four sections of the metal roof. Make connections electrically continuous and have a surface contact of at least 3 square inches.

3.2.2 Metal Roofs with Metal Walls

Bond metal roof and metal walls so that they are electrically continuous and considered as one unit. Connect air terminals to and make them electrically continuous with the metal roof as well as the roof down conductors. Bond all roof conductors and down conductors to metal roof or metal walls at upper and lower edges at intervals not to exceed 100 feet. Make all connections electrically continuous and have surface contact of at least 3 square inches.

3.2.3 Steel Frame Building

Make the steel framework of the building electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding unless another specific method is indicated. Connect air terminals to the structural steel framework at the ridge. Provide short runs of conductors to join air terminals to the metal framework so that proper placing of air terminals is maintained. Separate down conductors from air terminals to ground connections are not required. Where water system enters the building, securely connect structural steel framework and water system at point of entrance by a ground connector. Make connections to pipes by

means of ground clamps with lugs. Make connections to structural framework by means of nut and bolt or welding. Make connections between columns and ground connections at bottom of steel columns. Make ground connections to grounds or ground loop runs from not less than one-half of the columns distributed equally around perimeter of structure. When no water system enter the structure, run ground connections from steel columns distributed equally around the perimeter of the structure. Bond metal doors, windows, gutters, and similar metal installation to steel work of the building. Provide a grounding electrode for each ground connection.

3.2.4 Ramps and Covered Passageways

Ramps and covered passageways which are in the zone of protection of a lightning protection system, as defined by NFPA 780, need no additional lightning protection. However, ramps and covered passageways which are outside the zone of protection of a lightning protection system shall be provided with a lightning protection conforming to the requirements for lightning protection systems for buildings of similar construction. Place a down conductor and a driven ground at one of the corners where the ramp connects to each building or structure. Connect down conductor and driven ground to the ground loop or nearest ground connection of the building or structure. Where buildings or structures and connecting ramps are clad with metal, connect metal of the buildings or structures and metal of the ramp in a manner to ensure electrical continuity, in order to avoid the possibility of a flash-over or spark due to a difference in potential. Make connections electrically continuous and have a surface contact area of at least 3 square inches.

3.3 INTERFACE WITH OTHER STRUCTURES

3.3.1 Interconnection of Metal Bodies

Protect metal bodies when not within the zone of protection of air terminal. Bond metal bodies having an area of 400 square inches or greater or a volume of 1000 cubic inches or greater to lightning protection system using main size conductors and a bonding plate having a surface contact area of not less than 3 square inches. Make provisions to guard against the corrosive effect of bonding dissimilar metals. Bond metal bodies at their closest point to the lightning protection system using bonding conductors and fittings. Independently ground any metal body that exceeds 5 feet in any dimension, that is situated wholly within a building, and that does not at any point come within 6 feet of a lightning conductor or metal connected to a lightning protection system.

3.3.2 Fences

Except as specified below, metal fences that are electrically continuous with metal posts extending at least 2 feet into the ground require no additional grounding. Ground other fences on each side of every gate at gate posts, at corner posts, and at end posts. Bond gate to adjacent fence post utilizing flexible copper grounding braid with sufficient slack to permit 180 degree opening of the gate. Provide flexible copper ground braid which has an ampacity equivalent to that of the fence ground wire specified herein. Provide ground rods every 1000 to 1500 feet for grounding fences when fences are located in isolated places, and every 500 to 750 feet when in proximity (100 feet or less) to public roads, highways, and buildings. Provide connection to ground from the post where it is metal and is electrically continuous with the fencing using removable ground clamps on the fence posts and split-bolt connectors suitable for

dissimilar metals on the fence fabric and barbed wire. Make connections to ground from the horizontal metal strand using split-bolt connectors suitable for dissimilar metals on the fence fabric and barbed wire. Ground metal fences at or near points 150 feet on each side of medium and high voltage, (meaning in excess of 600 volts,) overhead line crossings. Ground metal fences at 150 foot intervals where high and medium voltage lines are directly overhead and run parallel to the fence.

3.3.3 Exterior Overhead Pipe Lines

Properly ground overhead pipes, conduits, and cable trays on the exterior of the building that enter a building, preferably to building grounds at points where pipes enter the building. Where a separate ground is provided, bond the pipes to the building ground at points where the pipes are closest to the ground connections. In addition, bond pipes to any metallic masses that are within 6 feet of the pipe.

3.4 RESTORATION

Where sod has been removed, place sod as soon as possible after completing the backfilling. Restore to original condition the areas disturbed by trenching, storing of dirt, cable laying, and other work. Include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging or mulching in any restoration. Maintain disturbed surfaces and replacements until final acceptance.

3.5 FIELD QUALITY CONTROL

3.5.1 Grounding System Test

Test the grounding system to ensure continuity and that resistance to ground is not in excess of 10 ohms. Test the ground rod for resistance to ground before making connections to the rod. Tie the grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Include in the written report: locations of ground rods, resistance, and soil conditions at the time that measurements were made. Submit results of each test to the COR.

3.5.2 Lightning Protection System Inspection

Make visual inspections to verify that there are no loose connections which may result in high resistance joints, and that conductors and system components are securely fastened to their mounting surfaces and are protected against accidental mechanical displacement.

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SECTION 26 51 00.00 40

INTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

This section covers interior lighting installations.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A368	Standard Specification for Stainless Steel Wire Strand
ASTM A467/A467M	Standard Specification for Machine Coil Chain
ASTM A47/A47M	Standard Specification for Ferritic Malleable Iron Castings
ASTM A580/A580M	Standard Specification for Stainless Steel Wire
ASTM A641/A641M	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 164	Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire

ASTM B 26/B 26M	Standard Specification for Aluminum-Alloy Sand Castings
ASTM B 633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM E 2129	Standard Practice for Data Collection for Sustainability Assessment of Building Products

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

CALIFORNIA ENERGY COMMISSION (CEC)

CEC Title 24	California's Energy Efficiency Standards for Residential and Nonresidential Buildings

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA HB-9	IES Lighting Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	National Electrical Safety Code
IEEE C62.41.1	Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE Stds Dictionary	IEEE Standards Dictionary: Glossary of Terms & Definitions

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C82.1	American National Standard for Electric Lamp Ballasts - Line Frequency Fluorescent Lamp Ballasts
ANSI C82.11	American National Standard for High-Frequency Fluorescent Lamp Ballasts--Supplements
ANSI C82.2	American National Standard for Lamp Ballasts--Methods of Measurement of Fluorescent Lamp Ballasts
ANSI/IEC C78.81	American National Standard for Electric Lamps--Double-Capped Fluorescent Lamps--Dimensional and Electrical Characteristics

ANSI/IEC C78.901	American National Standard for Electric Lamps - Single Base Fluorescent Lamps--Dimensional and Electrical Characteristics
ANSI/NEMA C78.LL 1256	Procedures for Fluorescent Lamp Sample Preparation and the Toxicity Characteristic Leaching Procedure (TCLP)
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	Energy Star Energy Efficiency Labeling System

UNDERWRITERS LABORATORIES (UL)

UL 1598	Luminaries
UL 844	Standard for Luminaries for Use in Hazardous (Classified) Locations
UL 8750	UL Standard for Safety for Light Emitting Diode (LED) Equipment for Use in Lighting Products
UL 935	Standard for Fluorescent-Lamp Ballasts

1.3 RELATED REQUIREMENTS

Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL. Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.

1.4 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Stds Dictionary.

b. Average life is the time after which 50 percent has failed and 50 percent has survived under normal conditions.

c. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

Employ the terminology, classifications, and methods prescribed by the IESNA HB-9, as applicable, for the lighting system specified in data, drawings, and reports.

SD-02 Shop Drawings

Submit Fabrication Drawings for the following items consisting of fabrication and assembly details to be performed in the factory.

Commercial Incandescent Lighting Fixtures

Industrial Incandescent Lighting Fixtures

Enclosed and Gasketed Vapor-Tight Fixtures

Incandescent Lamps

Lowering Devices

Submit Installation Drawings for the incandescent lighting fixtures in accordance with the paragraph entitled, "Installation," of this section.

SD-03 Product Data

Fluorescent lighting fixtures

Fluorescent electronic ballasts

Fluorescent electromagnetic ballasts

Fluorescent lamps

LEDlighting fixtures

LED lamps

Power hook fixture hangers

Light Level Sensor

Local/Regional Materials

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data

Enclosed and Gasketed Vapor-Tight Fixtures

Lowering Devices

SD-04 Samples

Lighting fixtures, complete with lamps and ballasts

SD-06 Test Reports

Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

Submit Test reports for Operational Tests on incandescent lighting fixtures in accordance with the paragraph entitled, "Field Testing," of this section.

SD-10 Operation and Maintenance Data

Lighting Control System, Data Package 5

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein, showing all light fixtures, control modules, control zones, occupancy sensors, light level sensors, power packs, dimming ballasts, schematic diagrams and all interconnecting control wire, conduit, and associated hardware.

Operational Service

Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.6 QUALITY ASSURANCE

1.6.1 Fluorescent Electronic Ballasts

Submit ballast catalog data as required in the paragraph entitled "Fluorescent Lamp Electronic Ballasts" contained herein. As an option, submit the fluorescent fixture manufacturer's electronic ballast specification information in lieu of the actual ballast manufacturer's catalog data. Include published specifications and sketches, which cover the information required by the paragraph entitled "Fluorescent Lamp Electronic Ballasts" herein. This information may be supplemented by catalog data if required, containing a list of vendors with vendor part numbers.

1.6.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the COR. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of CEC unless more stringent requirements are specified or indicated.

1.6.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship,which have been in satisfactory commercial

or industrial use for 2 years prior to bid opening. The 2-year period includes applications of equipment and materials under similar circumstances and of similar size, on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.3.1 Alternative Qualifications

Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.3.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than 3 years prior to date of delivery to site, unless specified otherwise.

1.6.3.3 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit documentation for Energy Star qualifications for equipment provided under this section. Submit data indicating lumens per watt efficiency and color rendition index of light source.

1.7 WARRANTY

Support the equipment items with service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7.1 Electronic Ballast Warranty

Furnish the electronic ballast manufacturer's warranty, for not less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage is not to exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. State in the warranty that the manufacturer agrees to exchange a malfunctioning ballast and promptly ship the replacement to the using Government facility,said replacement ballast being identical to, or an improvement upon, the original design of the malfunctioning ballast.

1.8 OPERATIONAL SERVICE

Coordinate with manufacturer for maintenance agreement for services which reclaim materials for recycling and/or reuse. Collect information from the manufacturer about maintenance agreement green lease options, and submit to COR. Placement into landfills or burning of reclaimed materials is not allowed. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, seek out local recyclers to reclaim the materials.

1.9 SUSTAINABLE DESIGN REQUIREMENTS

1.9.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

1.9.2 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products:

Fluorescent lamp
LED lamp

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Provide LED lighting fixtures in accordance with UL 8750 and project drawings. Provide fixtures in hazardous areas conforming to UL 844.

Furnish lighting fixtures completely assembled with wiring and mounting devices and ready for installation at the locations noted. Design and equip recessed fixtures in suspended ceilings for installation in the type of ceiling in which the fixture is to be installed. Design fixtures to be supported independent of the ceiling. Equip fixtures with the lamps required.

2.2 FLUORESCENT LIGHTING FIXTURES

Provide fluorescent fixtures, conforming to UL 1598 with electronic ballasts unless specifically indicated otherwise.

2.2.1 Fluorescent Lamp Electronic Ballasts

Provide electronic ballasts, meeting as a minimum, the following characteristics:

a. Provide ballasts complying with UL 935, ANSI C82.11, CEC, and CEC Title 24 unless specified otherwise. Provide 100 percent electronic high frequency type ballasts with no magnetic core and coil components, which provide transient immunity as recommended by IEEE C62.41.1 and IEEE C62.41.2. Design ballast for the wattage of the lamps used in the indicated application. Design ballasts to operate on the voltage system to which they are connected.

b. A power factor of 0.95 (minimum).

c. Operates at a frequency of 20,000 Hertz (minimum), and is compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.

d. Light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ensure ballasts have 10 percent flicker (maximum) using any compatible lamp.

e. A ballast factor between 0.85 (minimum) and 1.00 (maximum). Current

crest factor - 1.7 (maximum).

f. UL listed Class P with a sound rating of "A."

g. Include circuit diagrams and lamp connections displayed on the ballast.

h. Provide instant start ballasts which operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed. Provide programmed start ballast unless otherwise indicated. Programmed start ballasts may operate lamps in a series circuit configuration. Provide series/parallel wiring for programmed start ballasts where available.

i. Provide programmed start ballasts for compact fluorescent fixtures.

j. Provide ballasts for T-5 and smaller lamps with end-of-life protection circuits as required by ANSI/IEC C78.81 and ANSI/IEC C78.901 as applicable.

k. Provide ballasts capable of starting and maintaining operation at a minimum of 0 degrees F unless otherwise indicated.

l. Provide electronic ballasts with a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

2.2.1.1 T-8 Lamp Ballast

a. Total harmonic distortion (THD): 20 percent (maximum).

b. Input wattage.

1. 32 watts (maximum) when operating one F32T8 lamp

2. 62 watts (maximum) when operating two F32T8 lamps

3. 92 watts (maximum) when operating three F32T8 lamps

4. 114 watts (maximum) when operating four F32T8 lamps

c. Ballast efficacy factor.

1. 2.54 (minimum) when operating one F32T8 lamp

2. 1.44 (minimum) when operating two F32T8 lamps

3. 0.93 (minimum) when operating three F32T8 lamps

4. 0.73 (minimum) when operating four F32T8 lamps

d. Provide three and four lamp fixtures with two ballasts per fixture where multilevel switching is indicated.

e. A single ballast may be used to serve multiple fixtures if they are continuously mounted and factory manufactured for that installation with an integral wireway.

2.2.1.2 F17T8 Lamp Ballast

Provide F17T8 ballasts with:

a. Total harmonic distortion (THD): 25 percent (maximum).

b. Input wattage:

1. 34 watts (maximum) when operating two F17T8 lamps.

2.2.1.3 T-5 Long Twin Tube Lamp Ballast

a. Total harmonic distortion (THD): No greater than 25 percent when operating one lamp, 15 percent when operating two lamps, and 20 percent when operating three lamps.

b. Input wattage:

1. 45 watts (maximum) when operating one F40 T-5 lamps

2. 74 watts (maximum) when operating two F40 T-5 lamps

3. 105 watts (maximum) when operating three F40 T-5 lamps

c. Provide three and four lamp fixtures with two ballasts per fixture where multilevel switching is indicated.

d. A single ballast may be used to serve multiple fixtures if they are continuously mounted and factory manufactured for that installation with an integral wireway.

2.2.1.4 F96T8 Lamp Ballast

a. Total harmonic distortion (THD): No greater than 30 percent when operating one lamp and 20 percent when operating two lamps.

b. Input wattage:

1. 56 watts (maximum) when operating one F96T8 lamps

2. 102 watts (maximum) when operating two F96T8 lamps

c. A single ballast may be used to serve multiple fixtures if they are continuously mounted and factory manufactured for that installation with an integral wireway.

2.2.2 Light Level Sensor

UL listed. Provide light level sensor capable of detecting changes in ambient lighting levels, and providing a dimming range of 20 percent to 100 percent, minimum, designed for use with dimming ballast and voltage system to which they are connected. Ensure sensor is capable of controlling 40 electronic dimming ballast, minimum. Provide adjustable light level sensor with a set level range from 10 to 100 foot candles, minimum. Provide sensor with a bypass function to electrically override sensor control.

2.2.3 Fluorescent Electromagnetic Ballasts

2.2.3.1 Electromagnetic Energy-Saving Ballasts

ANSI C82.1. Provide energy-saving fluorescent ballasts of the CBM certified full light output type except where fixtures are provided with low temperature ballasts, with an average input wattage of 40 or less when operating one 32-watt F32T8 lamp 45 or less when operating two 17 watt F17T8 lamps 72 or less when operating two 32 watt F32T8 lamps 109 or less when operating two 59-watt F96T8 lamps or less when operating 2 amps tested in accordance with ANSI C82.2 methods. Provide ballasts which are compatible with energy-saving lamps.

2.2.3.2 Electromagnetic Ballasts for Compact Fluorescent Lamps

Provide electromagnetic ballasts for compact fluorescent lamps.

2.2.3.3 Electromagnetic Low Temperature Ballasts

Provide fluorescent ballasts having a minimum starting temperature of zero degrees F minus 20 degrees F for 800 milliampere, high output (HO) lamps in fixtures mounted in cold rooms, outdoors, in unheated buildings, and as indicated.

2.2.3.4 Electromagnetic Ballasts for T-5 Long Twin Tube Lamps

Provide electromagnetic ballasts with an average input wattage of 49 or less when operating one 86 or less when operating two 40-watt T-5 long twin tube lamps.

2.2.4 Fluorescent Lamps

a. Provide T-8 rapid start low mercury lamps rated 32 watts (maximum), 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, with an average rated life of 20,000 hours. Provide low mercury lamps which have passed the EPA Toxicity Characteristic Leachate Procedure (TCLP) for mercury by using the lamp sample preparation procedure described in ANSI/NEMA C78.LL 1256.

b. Provide T-8 rapid start lamp, 17 watt (maximum), nominal length of 24 inches, 1300 initial lumens, CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours.

c. Provide T-8 instant start lamp, 59 watts (maximum), nominal length of 96 inches, minimum CRI of 75, 5700 initial lumens, color temperature of 3500 K, and average rated life of 15,000 hours.

d. Provide , long twin tube fluorescent lamp, 40 watts (maximum), 3500 K, 22.6 inches maximum length, 20,000 hours average rated life, 3150 initial lumens, CRI of 80 (minimum), 2G11 Type base, 90 to 100 lumens/watt depending on wattage.

e. Provide compact fluorescent lamps: CRI 80, minimum, 3500 K, 10,000 hours average rated life, and as follows:

    1. T-4, twin tube, rated 5 watt, 250 initial lumens (minimum) 7 watts, 400 initial lumens (minimum), 9 watts, 600 initial lumens (minimum), and 13 watts, 825 initial lumens (minimum), as indicated.

2. T-4, double twin tube, rated 13 watts, 900 initial lumens (minimum), 18 watts, 1200 initial lumens (minimum), and 26 watts, 1800 initial lumens (minimum), as indicated.

Average rated life is based on 3 hours operating per start.

2.2.5 Compact Fluorescent Fixtures

Provide compact fluorescent fixtures manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Providing assemblies designed to retrofit incandescent fixtures is prohibited except when specifically indicated for renovation of existing fixtures. Provide fixtures using lamps as indicated, with a minimum CRI of 80.

2.2.5.1 Bare Bulb Retrofits

Replace 40-watt incandescent bulbs (495plus lumens) with 11- to 14-watt compact fluorescent bulbs (45 plus lumens per watt). Replace 60-watt incandescent bulbs (900 plus lumens) with 15- to 19-watt compact fluorescent bulbs (60 plus lumens per watt). Replace 75-watt incandescent bulbs (1200 plus lumens) with 20- to 25-watt compact fluorescent bulbs (60 plus lumens per watt). Replace 100-watt incandescent bulbs (1750 plus lumens) with 29-watt or greater compact fluorescent bulbs (60 plus lumens per watt).

2.2.5.2 Reflector Type Bulb Retrofits

Replace 50-watt incandescent bulbs (550 plus lumens) with 17- to 19-watt compact fluorescent bulbs (33 plus lumens per watt). Replace 60-watt incandescent bulbs (675 plus lumens) with 20- to 21-watt compact fluorescent bulbs (40 plus lumens per watt). Replace 75-watt incandescent bulbs (875 plus lumens) with 22-watt or greater compact fluorescent bulbs (40 plus lumens per watt).

2.2.6 Air Handling Fixtures

Provide fixtures used as air handling registers conforming to the requirements of NFPA 90A.

2.3 RECESS- AND FLUSH-MOUNTED FIXTURES

Provide type that can be relamped from the bottom, with access to ballast from the bottom, with trim for the exposed surface of flush-mounted fixtures as indicated.

2.4 SUSPENDED FIXTURES

Provide hangers capable of supporting twice the combined weight of fixtures supported by hangers. Provide with swivel hangers to ensure a plumb installation, cadmium-plated steel with a swivel-ball tapped for the conduit size indicated. Provide hangers which allow fixtures to swing within an angle of 45 degrees. Brace pendants 4 feet or longer provided in shops or hangers to limit swinging. Provide single-unit suspended fluorescent fixtures with twin-stem hangers. Provide multiple-unit or continuous row fluorescent fixtures with tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Provide rods with a minimum 0.18 inch diameter.

2.5 POWER HOOK FIXTURE HANGERS

Provide UL listed assembly including through-wired power hook housing, interlocking plug and receptacle, power cord, and fixture support loop. Provide power hook housing of cast aluminum having two 3/4 inch threaded hubs, including support hook with safety screw. Provide fixture support loop of cast aluminum with provisions for accepting 3/4 inch threaded fixture stems. Include with power cord 16 inches of 3 conductor No. 16 Type SO cord. Provide complete assembly rated 120 volts or 277 volts, 15 amperes.

2.6 SUPPORT HANGERS FOR LIGHTING FIXTURES IN SUSPENDED CEILINGS

2.6.1 Wires

ASTM A641/A641M, galvanized regular coating, soft temper, 0.1055 inches in diameter (12 gage).

2.6.2 Wires, for Humid Spaces

ASTM A580/A580M, composition 302 or 304, annealed stainless steel 0.1055 inches in diameter (12 gage).

ASTM B 164, UNS NO4400, annealed nickel-copper alloy 0.1055 inches in diameter (12 gage).

2.6.3 Straps

Galvanized steel, one by 3/16 inch, conforming to ASTM A653/A653M, with a light commercial zinc coating or ASTM A1008/A1008M with an electrodeposited zinc coating conforming to ASTM B 633, Type RS.

2.6.4 Rods

Threaded steel rods, 3/16 inch diameter, zinc or cadmium coated.

2.7 EQUIPMENT IDENTIFICATION

2.7.1 Manufacturer's Nameplate

Provide each item of equipment with a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.7.2 Labels

Provide labeled luminaries in accordance with UL 1598 requirements. Clearly mark all for operation of specific lamps and ballasts according to proper lamp type. Note the following lamp characteristics in the format "Use Only":

a. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaries.

b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaries.

c. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaries.

d. ANSI ballast type (M98, M57, etc.) for HID luminaries.

e. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaries.

Provide all markings related to lamp type clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Provide ballasts with clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.8 FACTORY APPLIED FINISH

Provide electrical equipment with factory-applied painting systems which , as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

2.9 COMMERCIAL INCANDESCENT LIGHTING FIXTURES

2.9.1 Surface-Mounted Fixtures

Design the surface-mounted fixtures to be fastened to wall or ceiling flush-mounted outlet boxes. Do not subject combustible ceiling materials to temperatures in excess of 195 degrees F.

2.9.2 Recessed Fixtures

Design recessed fixtures in suspended ceilings for the type of ceiling construction in which the fixture is to be installed. Do not subject combustible ceiling materials to temperatures in excess of 195 degrees F. Where recessed fixtures are supported on suspended ceilings, provide a minimum of four support rods per fixture with no support further than 6 inches from the edge of the fixture. Do not support fixtures by acoustic panels.

2.9.3 Pendant-Mounted Fixtures

Equip pendant-mounted fixtures with stems, swivel ball-and-socket self-aligning hangers that allow a minimum of a 20-degree angle swing, ceiling canopies, and fixture-hanging devices, made of seamless brass, aluminum, steel, corrosion-resistant steel tubing, or steel conduit not less than 1/2 inch in diameter. Stem length, material, and finish are as noted.

2.10 ENCLOSED AND GASKETED VAPOR-TIGHT FIXTURES

Provide enclosed and gasketed vapor-tight fixtures suitable for wet or damp locations consisting of a cast-aluminum body, cap or matching outlet box, porcelain lampholder, glass enclosing globe, cork gaskets, and cast-aluminum guards for wall, ceiling, or pendant mounting in accordance with UL 1598 and CEC.

Furnish exposed cast aluminum outlet boxes for wall- and ceiling-mounted fixtures with four tapped hubs 90 degrees apart circumferentially, with three cast-aluminum threaded pipe plugs to fit the tapped holes. Provide boxes with ears or lugs for surface mounting to wall or ceiling. Provide body with mounting screws and gasket to ensure a vapor-tight joint between the body and outlet box.

Concealed outlet boxes for wall- and ceiling-mounted fixtures may be standard sheet metal boxes. Provide fixture body with mounting screws and gasket to ensure a vapor-tight joint between the body and outlet box.

Seal body and cap for pendant-mounted fixtures with a gasket at the joint. Provide cast aluminum cap with top hub tapped for 1/2 inch tapered iron pipe threads.

Furnish cast aluminum exposed outlet boxes for pendant-mounted fixtures with the fixtures with four tapped hubs 90 degrees apart circumferentially, with three cast-aluminum threaded pipe plugs to fit the tapped holes. Supply boxes with ears or lugs for surface mounting to the ceiling. Provide cast aluminum outlet-box covers for concealed and exposed outlet boxes with the center hub tapped for 1/2 inch tapered iron pipe threads. Provide cover and outlet box with mounting screws and gasket to ensure a vapor-tight joint between the cover and outlet box. Also provide 1/2 inch galvanized rigid steel conduit stem.

Provide clear nondiffusing heat-resistant glass enclosing globe molded in one piece into a cylindrical shape with a closed bowl-shaped bottom and an open molded top bead or thread. Make edges of the open end either ground or molded to a smooth, true surface that will ensure a vapor-tight joint when the globe is fastened to the gasketed body.

Provide a cast-aluminum guard of the same shape as the glass enclosing globe which is affixed to the fixture body with threads or setscrews.

2.11 LOWERING DEVICES FOR HIGH-BAY LIGHTING FIXTURES

Provide lowering devices for high-bay lighting fixtures consisting of a hand-operated mechanism that will connect, disconnect, raise, and lower the lighting fixture and permit the servicing and maintenance of fixtures and equipment at floor level. Include with lowering device hangers, pulleys, beam clamps or suspension fittings, operating cable, hand chain, and cable and chain fittings.

Provide hanger consisting of a two-piece latching spring-loaded mechanism with an upper and lower separable contact assembly and stem and guide assembly, with cast-aluminum protective housings. Provide contacts for two-pole for single 2-wire circuits and four-pole for 3- and 4-wire circuits rated 15 amperes at 600 volts and 30 amperes at 250 volts ac.

Include with upper contact assembly an integrally mounted corner pulley with threaded hub for electrical-conduit connections and top flange with lugs for mounting.

Include with lower contact assembly fixture adapters and swivel end fittings for anchoring operating cable in the stem of the hanger, with adapters of hot-dip galvanized malleable iron.

Provide open face pulleys with cast-aluminum alloy housings and deep-grooved pulley wheels closely shrouded to prevent lines from becoming wedged between wheel and housing. Design pulleys to be straight through for top and bottom mounted operating cables and corner type as required. Hinge top mounted pulleys, with mounting lugs. Provide fixed bottom mounted pulleys, with mounting lugs. Bolt all pulleys to the supporting structure. Support horizontal runs of operating cable with pulleys located not more than 35-feet apart.

Include with terminal fittings an enclosed lockbox with hub tapped for 3/4 inch conduit, flared conduit end fitting, pulley wheel, locking hooks, and hinged cover with provisions for padlocking.

Provide cast-aluminum alloy lockbox and cover, with the flared conduit end fitting of hot-dip galvanized malleable iron.

Mount wall mounted lockbox not less than 43 inches and not more than 54 inches above the floor at the operating level. Provide pulley designed to permit horizontal pull operation of the lowering device at the operating level.

Provide 1/8 inch diameter operating cable, 7 by 19 stranded, heat- and corrosion-resistant steel aircraft cable with link, cable loops, and serving sleeves. Perform cable with detachable fittings designed for connection to the terminal fittings, conforming to ASTM A368.

Provide hand chains which are separate detachable hand lines to provide means for disconnecting, lowering, raising, and reconnecting fixtures after servicing and maintenance work has been completed. Provide hand chain equal in length to the mounting height of the fixture and equipped with a snap hook for connection to the terminal end of the operating cable, size 4, hot-dip galvanized steel, conforming to ASTM A467/A467M, Class MS machine, straight link, steel chain.

Provide cast-aluminum-alloy housings conforming to ASTM B 26/B 26M.

Provide malleable-iron fittings conforming to ASTM A47/A47M, and hot-dip galvanized coatings conforming to ASTM A123/A123M.

PART 3 EXECUTION

3.1 INSTALLATION

Ensure all electrical installations conform to IEEE C2, CEC, and to the requirements specified herein.

3.1.1 Lamps

Deliver lamps of the type, wattage, and voltage rating indicated to the project in the original cartons and installed just prior to project completion. Replace lamps installed and used for working light during construction prior to turnover to the Government if more than 15 percent of their rated life has been used. Test the lamps for proper operation prior to turn-over and replace if necessary with new lamps from the original manufacturer. Provide 10 percent spare lamps of each type from the original manufacturer.

3.1.2 Lighting Fixtures

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings, in conformance with the requirements of CEC. Mounting heights specified or indicated are to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being

installed. Independently support recessed and semi-recessed fixtures from the building structure by a minimum of four wires per fixture and located near each corner of each fixture. Ceiling grid clips are not allowed as an alternative to independently supported light fixtures. Independently support round fixtures smaller in size than the ceiling grid from the building structure by a minimum of four wires or straps or rods per fixture spaced approximately equidistant around the fixture. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently and provide at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the fixture. Provide wires or straps or rods for lighting fixture support in this section. Lighting fixtures installed in suspended ceilings are to comply with the requirements of Section 09 51 00 ACOUSTICAL CEILINGS.

3.1.3 Suspended Fixtures

Provide suspended fixtures with 45 degree swivel hangers so that they hang plumb and locate with no obstructions within the 45 degree range in all directions. Provide the stem, canopy and fixture capable of a 45 degree swing. Brace pendants, rods, or chains 4 feet or longer excluding fixture, to prevent swaying, using three cables at 120 degree separation. Provide suspended fixtures in continuous rows with internal wireway systems for end to end wiring and properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Use aligning splines on extruded aluminum fixtures to assure hairline joints. Support steel fixtures to prevent "oil-canning" effects. Provide fixture finishes free of scratches, nicks, dents, and warps, and matching the color and gloss specified. Provide pendants finished to match Provide stainless steel air craft cable. Provide canopies finished to match the ceiling and low profile unless otherwise shown. Ensure maximum distance between suspension points is 10 feet or as recommended by the manufacturer, whichever is less.

3.2 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Specify painting in Section 09 90 00 PAINTS AND COATINGS.

3.3 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that equipment operates in accordance with requirements of this section.

3.4 FIELD TESTING

Demonstrate that all incandescent lighting fixtures and their accessories, including lowering devices, operate satisfactorily in the presence of the COR.

Perform operational tests in accordance with referenced standards in this section.

-- End of Section --

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SECTION 26 60 13.00 40

LOW-VOLTAGE MOTORS

PART 1 GENERAL

1.1 SUMMARY

This section covers alternating current wattage fractional and integral horsepower motors rated up to190 kilowatt 250 hp when used on a 120-, 208- or 240-volt, single-or three-phase, 60-hertz power source and up to 225 kilowatt 300 hp when used on a 480-volt and 600-volt, three-phase, 60-hertz power source.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
ABMA 9	Load Ratings and Fatigue Life for Ball Bearings

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 112	Standard Test Procedure for Polyphase Induction Motors and Generators

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
NETA MAINT	Standard for Maintenance Testing Specifications for Electric Power Distribution Equipment and Systems

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1940-1	Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	Motors and Generators

U.S. DEPARTMENT OF ENERGY (DOE)

DOE CI-1	How to Buy a Premium Energy-Efficient Electric Motor

1.3 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Outline drawings for Motors shall indicate overall physical features, dimensions, ratings, service requirements, and weights of equipment.

SD-03 Product Data

Equipment and performance data shall be submitted for Motors consisting of use life, system functional flows, safety features, and mechanical automated details. Curves indicating tested and certified equipment response and performance characteristics shall also be submitted.

Submit Manufacturer's Catalog Data in accordance with paragraph entitled, "Equipment," of this section.

For Electric Motors rated over 7.5 and those specified to meet a special vibration class in accordance with NEMA MG 1 indicate number of:

Rotor Bars
Stator Slots
Rotational Speed
Cooling Fan Blades
Bearing Manufacturer
Bearing Style
Bearing Type
Balls/Elements
Commutator Bars
Commutator Brushes
SCR Firing Frequencies (for variable speed motors)

SD-07 Certificates

Certificates shall be submitted for the following tests showing conformance with the referenced standards contained in this section. Certified copies of previous test reports on identical motors may be submitted in lieu of factory test reports.

Factory Test Results
Efficiency
Power-Factor
Service Factor
Temperature Rating
Noise
Full-Load
Locked-Rotor
Insulation Resistance
Winding Resistance
High-Potential Tests

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted for Motors including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

1.5 DESIGN REQUIREMENTS

The following motor design data shall be provided prior to final turnover-number of motor rotor bars, Stator slots, rotational speed; number of cooling fan blades; RPM of motor; bearing manufacturer, bearing type, bearing style and number of balls/elements; number of commutator bars and commutator brushes; and SCR firing frequencies.

PART 2 PRODUCTS

2.1 EQUIPMENT

Submit manufacturer's catalog data for motors and enclosures.

Design, fabrication, testing, and performance of motors shall be in accordance with NEMA MG 1 and ISO 1940-1 and shall meet or exceed the requirements as specified herein.

Testing and performance of polyphase induction motors shall be in accordance with IEEE 112, Method B.

Efficiency labeling shall be in accordance with NEMA MG 1.

Allowable balance limits shall be in accordance with ISO 1940-1, Table 1

2.1.1 Efficiency

Motors shall have efficiencies in accordance with the recommended levels specified in DOE CI-1.

2.2 MOTOR TYPES

Motors shall be of the following types:

1/3 HP and smaller, single phase - capacitor start

1/2 HP and larger, three-phase - induction squirrel-cage type, NEMA Design B, having normal starting torque and low starting current

Motors shall be designed for across-the-line starting and shall be designed

with torque characteristics to carry the specified rated starting load.

Motors shall have factory-sealed ball bearings with an L-10 rated life of not less than 80,000 hours in accordance with ABMA 9 or ABMA 11.

2.3 SIZES OF MOTORS

2.3.1 Motors

Motors shall be of a sufficient size for the duty to be performed and shall not exceed the full-load rating when the driven equipment is operating at specified capacity under the most severe loading conditions.

2.3.2 Electrically Driven Equipment

When electrically driven equipment differs from that indicated, adjustments shall be made to the motor size, wiring and conduit systems, disconnect devices, and circuit protection to accommodate the equipment actually installed, at no additional cost to the Government. Control and protective devices shall be in accordance with Section 26 05 71.00 40 LOW-VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

2.4 VOLTAGE RATINGS

Motors shall have the following minimum voltage ratings:

MOTOR SIZE			MOTOR
MOTOR TYPE	HORSEPOWER	SERVICE	VOLTAGE RATING
Fractional horsepower, single-phase	1/3 and smaller	120/208-volt, 3-phase, 4-wire	115-volt, 60-hertz
Fractional and integral horsepower, 3-phase	1/2 and larger	120/208-volt, 3-phase, 4-wire	200-volt, 3-phase 60-hertz
Fractional and integral horsepower, 3-phase	1/2 and larger	480-volt, 3-phase, 3-wire	230/460-volt, 3-phase, 60-hertz

2.5 TEMPERATURE RATING AND INSULATION

Motors shall be designed for continuous operation at the rated full load in an ambient temperature of 104 degrees F.

Insulation level shall be at least Class F.

2.6 MOTOR HOUSINGS

The motor housing shall have a smooth surface in the vertical, horizontal, and axial directions at each bearing housing for attaching a magnet mounted accelerometer in order to monitor the motor vibration. The surface shall be on the bearing housing. The axial surface will be as close to the motor centerline as possible. The surface will have a finish of 63 micro-inch minimum. Diameter of finished surface shall be 2 inch minimum and must be corrosion resistant. As an option sound disks can be

used to meet the smooth surface requirement. Disk shall have a minimum thickness of 3/8 inch.

Surface shall be level within 1 degree or .001 inch.

The smooth surface shall be identified(using a label or plate) "Vibration data collection point - Do Not Paint"

2.7 MOTOR ENCLOSURES

Motors installed in indoor, clean, dry, nonhazardous locations shall have open-type drip-proof enclosures. Enclosures shall have a hinged access cover at each vibration collection point. Cover must be large enough to enable the placement of a magnet/accelerometer data collection instrument.

Motors installed in indoor, wet, nonhazardous locations shall have open splash-proof enclosures. Enclosures shall have a hinged access cover at each vibration collection point. Cover must be large enough to enable the placement of a magnet/accelerometer data collection instrument.

Motors installed in indoor, nonhazardous locations where it is necessary to protect the motor from dirt, moisture, chemical fumes, or other harmful ingredients in the surrounding atmosphere shall be the totally enclosed type, with either of the following:

Totally enclosed, not fan-cooled, enclosures not equipped for cooling by means external to the enclosing parts. Enclosures shall have a hinged access cover at each vibration collection point. Cover must be large enough to enable the placement of a magnet/accelerometer data collection instrument.

Totally enclosed fan-cooled enclosures for exterior cooling by means of a fan or fans integral with the machine but external to the enclosing parts. Enclosures shall have a hinged access cover at each vibration collection point. Cover must be large enough to enable the placement of a magnet/accelerometer data collection instrument.

Motors installed in outdoor, nonhazardous locations shall have waterproof enclosures.

Motors with weatherproof/waterproof enclosures shall have permanent accelerometers installed in the horizontal, vertical, and axial directions. The enclosure shall have a penetration installed to enable the accelerometer cables to be routed to outside the enclosure. A data collection box shall be mounted to the outside of the motor enclosure in a location that is easily accessible. Data collection box shall be rated NEMA 4R.

2.8 SERVICE FACTOR

Service factor of general purpose and other open ac motors shall be in accordance with NEMA MG 1.

Totally enclosed ac motors shall have a service factor of 1.15.

2.9 FACTORY TESTS

Factory test all motors in accordance with the requirements of NEMA MG 1. Polyphase induction motors shall be factory-tested in accordance with

IEEE 112, Method B. Tests shall consist of measurements of voltage, frequency, speed, and current under no-load conditions; voltage, frequency, and current under locked-rotor conditions; and efficiency, noise, power factor, and thermal protection. Routine tests on wound-rotor induction motors shall include the measurement of wound-rotor open-circuit voltage across the slip rings under locked-rotor conditions. Electrical tests shall consist of winding resistance, insulation resistance, and high-potential tests. Submit certified copies of factory test results for approval prior to shipment from the factory. Previous test reports on identical motors are not acceptable for these tests.

PART 3 EXECUTION

3.1 INSTALLATION

Motors shall be installed, aligned, and connected in accordance with the equipment manufacturer's instructions.

Motors shall be bolt mounted. Motor feet shall be coplanar within 0.001 inch. Base mounting points shall be accessible and adjustable to enable machine alignment. Motors over 15 hp shall have alignment jack bolts installed to enable alignment.

Alignment of motors shall be rechecked and adjusted as required after the motor has been in operation for not less than 48 hours.

3.2 ALIGNMENT

Before attempting alignment, the contractor will demonstrate that the load does not have any load/force imposed by the piping system. Minimum alignment values (below) are for motor and load at normal running temperatures. Values must be compensated for thermal growth. Limited movement of the motor or load (commonly known as bolt-bound) must be corrected to ensure alignment capability. Hold down bolts shall not be undercut in order to perform adjustment.

Shims shall be commercially die-cut, without seams or folds, and be made of corrosion resistant stainless steel. No more than four shims shall be used at any single point.

Motor and load shall be aligned to the following minimum specifications:

Speed(RPM)	Close-Coupled Offset (mils)	Close-Coupled Angle(mils/in.)	Spool Piece Angle (mils/in. @ coupling pt.)
600	6.0	2.0	3.0
900	5.0	1.5	2.0
1200	4.0	1.0	1.5
1800	3.0	0.5	1.0
3600	1.5	0.4	0.5
7200	1.0	0.3	0.4

Motor/load alignment shall be performed under the direction of the manufacturer's representative.

Final alignment settings shall be provided as part of the final test data.

3.3 ELECTRICAL TESTS

Perform continuity test on all phases.

Perform insulation resistance and polarization index test on each phase of motor. Insulation tests on 480-volt and 600-volt motors shall be conducted using a 1000-volt insulation test set. Insulation tests on motors rated less than 480-volts shall be conducted using 500-volt insulation test set.

Test data shall include the location and identification of motors and megohm readings versus time. Test data shall be recorded at 15, 30, 45 seconds, and in 1 minute increments thereafter up to 10 minutes. Megohm readings shall not be less than 25 megohms for each phase and each phase reading shall be within 10 percent of the other two.

Perform inspections and test procedures on all motors in accordance with NETA ATS and NETA MAINT 7.15.1 for rotating machinery, AC motors.

Calculate the polarization index of each phase by dividing the 10 minute reading by the 1 minute reading. The polarization index shall be greater than 1.25. Any values lower shall be rejected and the motor returned to the factory.

3.4 VIBRATION TESTS

3.4.1 Vibration Analyzer

Contractor shall use an Fast Fourier Transformer (FFT) analyzer to measure vibration levels. It shall have the following characteristics: A dynamic range greater than 70 dB; a minimum of 400 line resolution; a frequency response range of 5 Hz-10 KHz(300-600000 cpm); the capacity to perform ensemble averaging, the capability to use a Hanning window; auto-ranging frequency amplitude; a minimum amplitude accuracy over the selected frequency range of plus or minus 20 percent or plus or minus 1.5 dB.

An accelerometer, either stud-mounted or mounted using a rare earth, low mass magnet and sound disk(or finished surface) shall be used with the FFT analyzer to collect data. The mass of the accelerometer and its mounting shall have minimal influence on the frequency response of the system over the selected measurement range.

3.4.2 Vibration Data

Vibration data shall be collected in the axial, vertical, and horizontal direction for each motor bearing.

Two narrowband spectra for each data collection point shall be obtained in the following manner: For all machines regardless of operating speed, a 5 to 500 Hz spectrum with a minimum of 400 lines of resolution shall be obtained. An additional spectrum of 5 to 2500 or 5 to 5000 Hz shall be acquired for machines operating at or below 1800 RPM or greater than 1800 RPM, respectively.

Vibration limits shall conform to the following:

Frequency Range(CPM)	Vibration limit(inch/sec)
0.3xRPM to 0.8xRPM	0.04
0.8xRPM to 1.2xRPM	0.75

1.2xRPM to 3.5xRPM	0.04
3.5xRPM to 120,000cpm	0.03

Final test reports shall be provided to the COR. Reports shall have a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

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SECTION 27 10 00

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SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM

PART 1 GENERAL

1.1 SUMMARY

This section covers building telecommunications cabling systems using a physical star network topology for transporting telecommunications signals within a building.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM D 709	Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	The Authoritative Dictionary of IEEE Standards Terms

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-83-596	Optical Fiber Premises Distribution Cable

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA J-STD-607	Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
TIA-455-21	FOTP-21 - Mating Durability of Fiber Optic Interconnecting Devices
TIA-526-14	OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
TIA-526-7	OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

TIA-568-2	Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cable Components
TIA-568-C.1	Commercial Building Telecommunications Cabling Standard
TIA-568-C.3	Optical Fiber Cabling Components Standard
TIA-569	Commercial Building Standard for Telecommunications Pathways and Spaces
TIA-570	Residential Telecommunications Infrastructure Standard
TIA/EIA-598	Optical Fiber Cable Color Coding
TIA/EIA-604-12	FOCIS 12 Fiber Optic Connector Intermateability Standard Type MT-RJ
TIA/EIA-604-2	FOCIS 2 Fiber Optic Connector Intermateability Standard
TIA/EIA-604-3	Fiber Optic Connector Intermateability Standard (FOCIS), Type SC and SC-APC, FOCIS-3
TIA/EIA-606	Administration Standard for the Telecommunications Infrastructure

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 68	Connection of Terminal Equipment to the Telephone Network (47 CFR 68)

UNDERWRITERS LABORATORIES (UL)

UL 1286	Office Furnishings
UL 1666	Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
UL 1863	Communication Circuit Accessories
UL 467	Grounding and Bonding Equipment
UL 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 969	Standard for Marking and Labeling Systems

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568-C.1, TIA-568-2, TIA-568-C.3, TIA-569, TIA/EIA-606 and IEEE 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

1.3.2 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

1.3.3 Floor Distributor (FD)

A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)

1.3.4 Telecommunications Room (TR)

An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

1.3.5 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

1.3.6 Entrance Room (ER) (Telecommunications)

A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.7 Open Cable

Cabling that is not run in a raceway as defined by CEC. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

1.3.8 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The building telecommunications cabling and pathway system shall include permanently installed backbone and horizontal cabling, horizontal and backbone pathways, service entrance facilities, work area pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for splicing, terminating, and interconnecting cabling necessary to transport telephone and data (including LAN) between equipment items in a building. The horizontal system shall be wired in a star topology from the telecommunications work area to the floor distributor or campus distributor at the center or hub of the star. The backbone cabling and pathway system includes intrabuilding and interbuilding interconnecting cabling, pathway, and terminal hardware. The intrabuilding backbone provides connectivity

from the floor distributors to the building distributors or to the campus distributor and from the building distributors to the campus distributor as required. The backbone system shall be wired in a star topology with the campus distributor at the center or hub of the star. The interbuilding backbone system provides connectivity between the campus distributors. Provide telecommunications pathway systems referenced herein as specified in Section 26 05 00.00 COMMON WORK RESULTS FOR ELECTRICAL.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications drawings

Telecommunications Space Drawings

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Telecommunications cabling (backbone and horizontal)

Patch panels

Telecommunications outlet/connector assemblies

Equipment support frame

Connector blocks

SD-06 Test Reports

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SD-07 Certificates

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SD-09 Manufacturer's Field Reports

Factory reel tests

SD-10 Operation and Maintenance Data

Telecommunications cabling and pathway system Data Package 5

SD-11 Closeout Submittals

Record Documentation

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

In exception to Section 01 33 00, SUBMITTAL PROCEDURES, submit shop drawings a minimum of 14 by 20 inches in size using a minimum scale of 1/8 inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Drawings

Provide drawings in accordance with TIA/EIA-606. The identifier for each termination and cable shall appear on the drawings. Drawings shall depict final telecommunications installed wiring system infrastructure in accordance with TIA/EIA-606. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the EF telecommunications and ER telecommunications, CD's, BD's, and FD's to the telecommunications work area outlets. The following drawings shall be provided as a minimum:

a. T1 - Layout of complete building per floor - Building Area/Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways. Layout of complete building per floor. The drawing indicates location of building areas, serving zones, vertical backbone diagrams, telecommunications rooms, access points, pathways, grounding system, and other systems that need to be viewed from the complete building perspective.

b. T2 - Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID’S). Shows a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.

1.6.1.2 Telecommunications Space Drawings

Provide T3 drawings in accordance with TIA/EIA-606 that include telecommunications rooms plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and cabinet, rack, backboard and wall elevations. Drawings shall show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.

1.6.2.2 Key Personnel

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and

construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the COR.

Note that only the key personnel approved by the COR in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The COR.

1.6.3 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the UTP and optical fiber components and accessories 60 days prior to the proposed test date. Include procedures for certification, validation, and testing.

1.6.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the COR. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of CEC unless more stringent requirements are specified or indicated.

1.6.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.7 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

1.8 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis

during the warranty period of the contract.

1.9 MAINTENANCE

1.9.1 Operation and Maintenance Manuals

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications cabling and pathway system. In addition to requirements of Data package 5, include the requirements of paragraphs TELECOMMUNICATIONS DRAWINGS, TELECOMMUNICATIONS SPACE DRAWINGS, and RECORD DOCUMENTATION.

1.9.2 Record Documentation

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA/EIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided in hard copy format shall be provided. Provide the following T5 drawing documentation as a minimum:

a. Cables - A record of installed cable shall be provided in accordance with TIA/EIA-606. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility in accordance with TIA/EIA-606. Include manufacture date of cable with submittal.

b. Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided in accordance with TIA/EIA-606. Documentation shall include the required data fields as a minimum in accordance with TIA/EIA-606.

1.9.3 Spare Parts

In addition to the requirements of Section 01 78 23, OPERATION AND MAINTENANCE DATA, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

PART 2 PRODUCTS

2.1 COMPONENTS

UL or third party certified. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the COR. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard. Provide a complete system of telecommunications cabling and pathway components using star topology. Provide support structures and pathways, complete with outlets, cables, connecting hardware and telecommunications cabinets/racks. Cabling

and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with CEC and conform to the requirements specified herein.

2.2 TELECOMMUNICATIONS PATHWAY

Provide telecommunications pathways in accordance with TIA-569 and as specified in Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL. Provide system furniture pathways in accordance with UL 1286.

2.3 TELECOMMUNICATIONS CABLING

Cabling shall be UL listed for the application and shall comply with TIA-568-C.1, TIA-568-2, TIA-568-C.3 and CEC. Provide a labeling system for cabling as required by TIA/EIA-606 and UL 969. Cabling manufactured more than 12 months prior to date of installation shall not be used.

2.3.1 Backbone Cabling

2.3.1.1 Backbone Optical Fiber

Provide in accordance with ICEA S-83-596, TIA-568-C.3, UL 1666 and CEC. Cable shall be imprinted with fiber count, fiber type and aggregate length at regular intervals not to exceed 40 inches.

Provide the number of strands indicated, (but not less than 12 strands between the main telecommunication room an each of the other telecommunication rooms), of single-mode (OS1), tight buffered fiberoptic cable.

Provide plenum (OFNP), riser (OFNR), or general purpose (ORN or OFNG) rated non-conductive, fiberoptic cable in accordance with CEC. Substitution of a higher rated cable shall be permitted in accordance with CEC. The cable cordage jacket, riber, unit, and gorup color shall be in accordance with TIA/EIA-598.

Provide plenum (ORNP), riser (OFNR), or general purpose (OFN or OFNG) rated non-conductive, fiberoptic cable in accordance with CEC. Substitution of a higher rated cable shall be permitted in accordance with CEC. The cable cordage jacket, fiber, unit, and group color shall be in accordance with TIA/EIA-598.

2.3.2 Horizontal Cabling

Provide horizontal cable in compliance with CEC and performance characteristics in accordance with TIA-568-C.1.

2.3.3 Work Area Cabling

2.3.3.1 Work Area Copper

Provide work area copper cable in accordance with TIA-568-2, with a blue, thermoplastic jacket.

2.3.3.2 Work Area Optical Fiber

Provide optical work area cable in accordance with TIA-568-C.3.

2.4 TELECOMMUNICATIONS SPACES

Provide connecting hardware and termination equipment in the telecommunications entrance facility to facilitate installation as shown on design drawings for terminating and cross-connecting permanent cabling. Provide telecommunications interconnecting hardware color coding in accordance with TIA/EIA-606.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

2.5.1 Outlet/Connector Copper

Outlet/connectors shall comply with FCC Part 68TIA-568-C.1, and TIA-568-2. UTP outlet/connectors shall be UL 1863 listed, non-keyed, 8-pin modular, constructed of high impact rated thermoplastic housing and shall be third party verified. Outlet/connectors provided for UTP cabling shall meet or exceed the requirements for the cable provided. Outlet/connectors shall be terminated using a Type 110 IDC PC board connector, color-coded for both T568A and T568B wiring. Each outlet/connector shall be wired T568A or T568B. UTP outlet/connectors shall comply with TIA-568-2 for 200 mating cycles. UTP outlet/connectors installed in outdoor or marine environments shall be jell-filled type containing an anti-corrosive, memory retaining compound.

2.5.2 Optical Fiber Connectors

Provide in accordance with TIA-455-21. Optical fiber connectors shall be duplex LC in accordance with TIA/EIA-604-3 with zirconia ceramic alignment sleeves, duplex SC in accordance with TIA/EIA-604-12 with thermoplastic ST in accordance with TIA/EIA-604-2 with metallic ferrule, epoxyless crimp style compatible with50/125 multimode fiber. The connectors shall provide a maximum attenuation of 0.3 dB at 1300 nm with less than a 0.2 dB change after 500 mating cycles.

2.5.3 Cover Plates

Telecommunications cover plates shall comply with UL 514C, and TIA-568-C.1, TIA-568-2, TIA-568-C.3; flush surface or oversized design constructed of high impact thermoplastic material ivory in color. Provide labeling in accordance with the paragraph LABELING in this section.

2.6 MULTI-USER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

Provide MUTOA(s) in accordance with TIA-568-C.1.

2.7 GROUNDING AND BONDING PRODUCTS

Provide in accordance with UL 467, TIA J-STD-607, and CEC. Components shall be identified as required by TIA/EIA-606. Provide ground rods, bonding conductors, and grounding busbars as specified on the drawings.

2.8 FIRESTOPPING MATERIAL

Provide as required by CEC Article 300.21.

2.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be

acceptable.

2.10 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inches thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inches high normal block style.

PART 3 EXECUTION

3.1 INSTALLATION

Install telecommunications cabling and pathway systems, including the horizontal and pathway systems, telecommunications outlet/connector assemblies, and associated hardware in accordance with TIA-568-C.1, TIA-568-2, TIA-568-C.3, TIA-569, CEC, and UL standards as applicable. Provide cabling in a star topology network. Pathways and outlet boxes shall be installed as specified in Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL. Install telecommunications cabling with copper media in accordance with the following criteria to avoid potential electromagnetic interference between power and telecommunications equipment. The interference ceiling shall not exceed 3.0 volts per meter measured over the usable bandwidth of the telecommunications cabling. Cabling shall be run with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

3.1.1 Cabling

Install UTP and optical fiber telecommunications cabling system as detailed in TIA-568-C.1, TIA-568-2. Screw terminals shall not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not untwist Category 5e UTP cables more than one half inch from the point of termination to maintain cable geometry. Provide service loop on each end of the cable, 10 feet in the telecommunications room, and 12 inches in the work area outlet. Do not exceed manufacturers' cable pull tensions for copper. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables with staples. For UTP cable, bend radii shall not be less than four times the cable diameter. Cables shall be terminated; no cable shall contain unterminated elements. Cables shall not be spliced. Label cabling in accordance with paragraph LABELING in this section.

3.1.1.1 Backbone Cable

a. Copper Backbone Cable. Install intrabuilding backbone copper cable, in indicated pathways, between the campus distributor, located in the telecommunications entrance facility or room, the building distributors and the floor distributors located in telecommunications rooms and telecommunications equipment rooms as indicated on drawings.

3.1.1.2 Horizontal Cabling

Install horizontal cabling as indicated on drawings. Do not untwist Category 5e UTP cables more than one half inch from the point of termination to maintain cable geometry. Provide slack cable in the form of a figure eight (not a service loop) on each end of the cable, 10 feet in the telecommunications room, and 12 inches in the work area outlet.

3.1.2 Pathway Installations

Provide in accordance with TIA-569 and CEC. Provide building pathway as specified in Section 26 05 00.00 40, COMMON WORK RESULTS FOR ELECTRICAL.

3.1.3 Service Entrance Conduit, Overhead

Provide service entrance overhead as specified in Section 26 05 00.00 40, COMMON WORK RESULTS FOR ELECTRICAL.

3.1.4 Service Entrance Conduit, Underground

Provide service entrance underground as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEMS.

3.1.5 Work Area Outlets

3.1.5.1 Terminations

Terminate UTP cable in accordance with TIA-568-C.1, TIA-568-2 and wiring configuration as specified. Terminate fiber optic cables in accordance with TIA-568-C.3

3.1.5.2 Cover Plates

As a minimum, each outlet/connector shall be labeled as to its function and a unique number to identify cable link in accordance with the paragraph LABELING in this section.

3.1.5.3 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 12 inches of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturer's bend radius for each type of cable shall not be exceeded.

3.1.5.4 Pull Cords

Pull cords shall be installed in conduit serving telecommunications outlets that do not have cable installed.

3.1.5.5 Multi-User Telecommunications Outlet Assembly (MUTOA)

Run horizontal cable in the ceiling or underneath the floor and terminate each cable on a MUTOA in each individual zone. MUTOAs shall not be located in ceiling spaces, or any obstructed area. MUTOAs shall not be installed in furniture unless that unit of furniture is permanently secured to the building structure. MUTOAs shall be located in an open work area so that each furniture cluster is served by at least one MUTOA. The MUTOA shall be limited to serving a maximum of twelve work areas. Maximum work area cable length requirements shall also be taken into account. MUTOAs must be

labeled to include the maximum length of work area cables. MUTOA labeling is in addition to the labeling described in TIA/EIA-606, or other applicable cabling administration standards. Work area cables extending from the MUTOA to the work area device must also be uniquely identified and labeled.

3.1.6 Telecommunications Space Termination

Install termination hardware required for Category 5e and optical fiber system. An insulation displacement tool shall be used for terminating copper cable to insulation displacement connectors.

3.1.6.1 Connector Blocks

Connector blocks shall be cabinetmounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Install in accordance with industry standard wire routing guides in accordance with TIA-569.

3.1.6.2 Equipment Support Frames

Install in accordance with TIA-569:

a. Bracket, wall mounted. Mount bracket to plywood backboard in accordance with manufacturer's recommendations. Mount rack so height of highest panel does not exceed 78 inches above floor.

b. Racks, floor mounted modular type. Permanently anchor rack to the floor in accordance with manufacturer's recommendations.

c. Cabinets, freestanding modular type. When cabinets are connected together, remove adjoining side panels for cable routing between cabinets. Mount rack mounted fan in base of cabinet.

d. Cabinets, wall-mounted modular type. Mount cabinet to plywood backboard in accordance with manufacturer's recommendations. Mount cabinet so height of highest panel does not exceed 78 inches above floor.

3.1.7 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings as specified.

3.1.8 Grounding and Bonding

Provide in accordance with TIA J-STD-607, CEC and as specifiedon the drawings.

3.2 LABELING

3.2.1 Labels

Provide labeling in accordance with TIA/EIA-606. Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits shall be provided using laser printer.

3.2.2 Cable

Cables shall be labeled using color labels on both ends with identifiers in accordance with TIA/EIA-606.

3.2.3 Termination Hardware

Workstation outlets and patch panel connections shall be labeled using color coded labels with identifiers in accordance with TIA/EIA-606.

3.3 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 TESTING

3.5.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA-568-C.1, TIA-568-2, TIA-568-C.3. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.

3.5.1.1 Inspection

Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568A or T568B pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1, TIA-568-2, TIA-568-C.3, and TIA-570. Visually confirm Category 5e, marking of outlets, cover plates, outlet/connectors, and patch panels.

3.5.1.2 Verification Tests

UTP backbone copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connected.

For multimode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568-C.3 and TIA-526-14 using Method A, Optical Power Meter and Light Source Method B, OTDR. For single-mode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568-C.3 and TIA-526-7 using Method A, Optical Power Meter and Light Source for single-mode optical fiber. Perform verification acceptance tests.

3.5.1.3 Performance Tests

Perform testing for each outlet and MUTOA as follows:

a. Perform Category 5e link tests in accordance with TIA-568-C.1 and TIA-568-2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay and delay skew.

b. Optical fiber Links. Perform optical fiber end-to-end link tests in accordance with TIA-568-C.3.

3.5.1.4 Final Verification Tests

Perform verification tests for UTP and optical fiber systems after the complete telecommunications cabling and workstation outlet/connectors are installed.

a. Voice Tests. These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and DSN telephone call.

b. Data Tests. These tests assume the Information Technology Staff has a network installed and are available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

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SECTION 27 21 00.00 40

INTERCOMMUNICATION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

This section covers five different types of intercommunication systems one of which shall be selected for the project.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S3.2	Method for Measuring the Intelligibility of Speech Over Communication Systems (ASA 85)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1	Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 50	Enclosures for Electrical Equipment, Non-environmental Considerations
UL 6	Electrical Rigid Metal Conduit-Steel
UL 797	Electrical Metallic Tubing -- Steel

1.3 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein.

1.4 SYSTEM DESCRIPTION

1.4.1 Performance Requirement for Type 1 System

Solid state, modular in design, and shall be of the wired type with a single master with remote stations. Station shall have capacity for later expansion to 1 master and 10 remote stations with handset without sacrificing any equipment or feature performance.

1.4.1.1 Sound Reproduction

The intercommunication system shall reproduce at all receiving stations a 30 dB dynamic range of a 40 dB minimum input signal referenced to sound pressure level (SPL) over the frequency range of 300 to 3300 Hz. Unless otherwise specified, SPL shall be 20 micro Pascal (0.00002 Newtons per square meter). The root-mean square (rms) extraneous noise (e.g. hum) level introduced by the intercommunication system shall be at least 30 dB below the nominal signal level. Distortion, including envelope delay, intermodulation, cross talk, and other nonlinear source, shall not exceed 5 percent.

1.4.1.2 System Performance

Provide system with normally acceptable speech intelligibility, defined as a score of at least 75 percent obtained utilizing the phonetically balanced monosyllabic work intelligibility test in accordance with ASA S3.2.

1.4.1.3 System Operation and Service Features

a. Provide the system with a power switch and an associated pilot light for ON and OFF operations. Include a volume switch at each station to regulate listening volume. Unless otherwise specified, operate the system on 120 Vac, single phase, 60 Hz source.

b. All master stations shall have a "call-in" switch to provide an audible and visual indication of incoming calls from remote station. Individual visual indication shall identify calling station and status, and remain actuated until a call is answered by a master station.

c. In addition to the manufacturer's standard identification plates, provide engraved laminated phenolic identification plates for each component connection and terminal identification labels, and shall be 3-layer black on white on black, engraved to show white letters on black background. Warning or caution labels shall be 3-layers red on white on red, engrave to show white letters on red background. Clearly mark control switches and knobs with their function and status. Locate identification strips for station selector switches to clearly identify remote and master stations and protect by transparent plastic inserts. Lettering shall be a minimum of 1/4 inch high, normal block style.

d. At speaker/handset stations, lifting the handset shall automatically cut out the loudspeaker in the station and all conversation shall be carried through handset.

e. Provide a privacy switch at each remote station. In the ON position, the switch shall prevent any transmission of sound from the remote station. When in the OFF position, without further switch manipulation, the station shall respond to incoming calls upon voice

activation from anywhere within 20 footradius of station.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Intercommunication system

Submit for overall system and for each major component. Illustrate how each item of equipment will function in the system and include an overall system schematic indicating relationship of intercommunication units on one diagram identifying type, size, and number of wiring, conduits and each major component.

SD-03 Product Data

Materials and equipment for Type 1 system

Paging system equipment

Public address and monitoring system equipment

Cables and raceways

Surge protection

SD-10 Operation and Maintenance Data

Intercommunication system, Data Package 5

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 EQUIPMENT AND COMPONENTS

Equipment and components shall conform to applicable requirements of CEC. Units of the same type of equipment shall be the product of a single manufacturer. Units to be mounted outdoors or subject to inclement conditions shall be weatherproof or shall be mounted in weatherproof enclosures.

2.1.1 Type 1 System: Direct Connected Keyed Intercommunication System

Provide master stations and remote stations in the quantities indicated. Each master station shall selectively communicate with any other master station and with any remote station by actuation of an appropriate selector switch. Each master station shall be capable of initiating a message to all other master stations and all remote stations simultaneously or in groups of not less than ten stations per group.

2.1.1.1 Master Station

Desk-mounted master stations shall as a minimum conform to the following specifications:

a. Capacity: Accommodate 30 stations

b. Speaker sensitivity: Minimum 40 dB

2.1.1.2 Intercommunication Amplifier

Intercommunication amplifier shall as a minimum conform to the following specifications:

a. Output power: 2 watts rms or greater

b. Total harmonic distortion: Less than 5 percent at rated power with a load equivalent to one station connected to output terminals

c. Signal-to-noise ratio: 60 dB or greater at rated output

d. Frequency response ratio: Plus or minus 2 dB from 200 Hz to 10,000 Hz

2.1.1.3 Remote Station

Desk-mounted remote station shall have anodized aluminum faceplate with tamper proof mounting screws and galvanized steel backbox with "station call-in" capabilities. Remote station shall provide a speaker with a minimum sensitivity of 40 dB for speakers less than 8 inches in diameter and 45 dB for speakers 8 inches or greater. Remote station shall have a call announcement monitor lamp and recurring momentary tone.

2.1.1.4 All-Call Amplifier

All-call amplifier shall as a minimum conform to the following specifications:

a. Output power: Minimum of 0.5 watts for each station

b. Total harmonic distortion: Less than 5 percent at rated power with a load equivalent to the quantity of stations connected to it in all-call mode of operation

c. Signal-to-noise ratio: 60 dB or greater at rated output

d. Frequency response ratio: Plus or minus 2 dB from 200 Hz to 10,000 Hz

2.2 CABLES AND RACEWAYS

Cable and raceways shall conform to UL 6 and UL 797. Cabinets and boxes shall conform to UL 50. Cables for use in air plenums shall be UL classified low smoke and low flame in accordance with CEC.

2.2.1 Speaker Cable

Basic cables shall be single twisted pair shielded cables, 22 gage, stranded tinned copper with vinyl insulation aluminum polyester shield, stranded tinned copper wire with overall vinyl jacket. Multi-conductor shielded pair cables conforming to basic speaker cable specifications are acceptable.

2.2.2 Microphone Cable

Cable shall be single conductor shielded cable stranded copper No. 25 AWG rubber insulated, tinned copper shield and rubber overall jacket.

2.3 TERMINALS

Terminals shall be solderless, tool-crimped pressure type.

2.4 SURGE PROTECTION

Major components of the system such as master stations, amplifiers, and remote stations, shall have a device, either internal or external, which shall provide protection against voltage spikes and current surges conforming to IEEE C62.41.1 and IEEE C62.41.2.

2.5 SPEAKER ENCLOSURES

Speaker enclosures shall be compatible with the speakers specified and shall comply with UL 50.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

A new intercommunications system station shall be installed in the N231 SVS Steam Boiler Plant Control Room to communicate with three other locations: the existing N234A Boiler House Control Room, the N234 Arc Jet Control Room, and the N238 Arc Jet Control Room. An existing intercommunications system paging panel is located in the basement of N238, which utilizes Clear-Com ICS-22 Intercom System components for communications between N234A, N234 and N238. The new intercommunications system shall either interface with the existing components, or new components shall be provided to replace existing components. Refer to Drawings A331-1102-E103 (Overhead Conduits for Communication and Control Routing Plan), A331-1102-J101 (Control Room Layout) and A331-1102-J602 (Control System Block Diagram) for additional information on the intercommunications system.

Install all system components and appurtenances in accordance with the manufacturer's instructions and as specified herein.

3.1.2 Wiring

Install wiring in rigid metal conduit, intermediate metal conduit, cable tray, or electric metallic tubing as specified in Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL. Wiring for signal circuits shall terminate on identified terminal blocks in cabinets and master station enclosures. Terminate audio circuits on identified terminal blocks in cabinets and master stations. Ground cable shield at all points of termination.

3.1.2.1 Signal Wiring and Control Wiring

Install signal and control circuits in accordance with CEC. Provide type of signal and control wires and number of conductors as recommended by the intercommunication system manufacturer, and as necessary to provide a complete and operable system.

3.1.3 Grounding

CEC. Ground and distribution ground buses shall be copper wire with insulating covering.

3.2 FIELD QUALITY CONTROL

3.2.1 Acceptance Tests

After installation has been completed, Contractor shall conduct an acceptance test in the presence of the COR to demonstrate that the equipment operates in accordance with specification requirements. Contractor shall notify the COR 2 weeks prior to performance of tests. The acceptance tests shall include originating and accepting messages at specified stations, at proper volume levels, without cross-talk or noise from other links or non-designated units. Test shall utilize the phonetically balanced monosyllabic work intelligibility test in accordance with ASA S3.2. In order to be acceptable a score of at least 75 percent must be obtained for each system test.

3.2.2 Retesting

Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense.

3.3 INSPECTION

Make observations to verify that units and controls are properly labeled, and interconnecting wires and terminals identified.

-- End of Section --

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ELECTRONIC SECURITY SYSTEM

PART 1 GENERAL

1.1 SUMMARY

This section covers an intrusion detection and electronic entry control system.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 142	Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book
IEEE C2	National Electrical Safety Code
IEEE C62.41.1	Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 7810	Identification Cards - Physical Characteristics
ISO 7811-1	Identification Cards - Recording Technique - Part 1: Embossing
ISO 7811-2	Identification Cards - Recording Technique - Part 2: Magnetic Stripe - Low Coercivity

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA ICS 1	Standard for Industrial Control and Systems: General Requirements

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-568-C.1	Commercial Building Telecommunications Cabling Standard

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 1037	Safety Antitheft Alarms and Devices
UL 1076	Proprietary Burglar Alarm Units and Systems
UL 294	Access Control System Units
UL 639	Standard for Intrusion Detection Units
UL 681	Installation and Classification of Burglar and Holdup Alarm Systems
UL 796	Standard for Printed-Wiring Boards

1.3 DEFINITIONS

1.3.1 Identifier

A card credential, keypad personal identification number or code, biometric characteristic or any other unique identification entered as data into the entry control database for the purpose of verifying the identity of an individual. Identifiers shall be used by the ESS for the purpose of validating passage requests for areas equipped with entry control equipment.

1.3.2 Entry Control Devices

Any equipment which gives a user the means to input identifier data into the entry control system for verification.

1.3.3 Facility Interface Device

A facility interface device shall be any type of mechanism which is controlled in response to passage requests and allows passage through a portal.

1.3.4 Portal

Specific control point, such as a door or a gate, providing entry or access from one security level to another.

1.4 SYSTEM DESCRIPTION

Provide an Electronic Security System (ESS) as described and shown including installation of any Government Furnished Equipment. All computing devices, as defined in 47 CFR 15, shall be certified to comply with the requirements for Class A computing devices and labeled as set forth in 47 CFR 15. Electronic equipment shall comply with 47 CFR 15.

1.4.1 Central Station

Configure the central station to provide operator interface, interaction, dynamic and real time monitoring, display, and control. The central station shall control system networks to interconnect all system components including peer or subordinate workstations, enrollment stations and field equipment. The system shall be able to manage up to 16,000 uniquely identifiable inputs and outputs.

1.4.2 Systems Networks

System networks shall interconnect all components of the system. These networks shall include communications between a central station and any peer or subordinate workstations, enrollment stations, local annunciation stations, portal control stations or redundant central stations. The systems network shall provide totally automatic communication of status changes, commands, field initiated interrupts and any other communications required for proper system operation. System communication shall not require operator initiation or response. System communication shall return to normal after any partial or total network interruption such as power loss or transient upset. The system shall automatically annunciate communication failures to the operator with identification of the communication link that has experienced a partial or total failure. A communications controller may be used as an interface between the central station display systems and the field device network. The communications controller shall provide those functions needed to attain the specified network communications performance.

1.4.2.1 Console Network

A console network, if required, shall provide communication between a central station and any subordinate or separate stations of the system. Where redundant central or parallel stations are required, the console network shall allow the configuration of stations as master and slave. The console network may be a part of the field device network or may be separate depending upon the manufacturer's system configuration.

1.4.2.2 Field Device Network

The field device network shall provide communication between a central control station and field devices of the system. The field device network shall be configured as shown in the drawings. Field devices shall consist of alarm annunciation local processors and entry control local processors. Each field device shall be interrogated during each interrogation cycle. The field device network shall provide line supervision that detects and annunciates communications interruptions or compromised communications between any field device and the central station.

1.4.3 Intercom Interface

Provide an interface for connection of the central station to the

intercommunication systems as specified in Section 27 21 00.00 40 INTERCOMMUNICATION SYSTEM and as shown. This shall not be accomplished by using an electro-mechanical relay assembly.

1.4.4 Electrical Requirements

Electrically powered ESS equipment shall operate on 120 volt 60 Hz ac sources as shown. Equipment shall be able to tolerate variations in the voltage source of plus or minus 10 percent, and variations in the line frequency of plus or minus 2 percent with no degradation of performance.

1.4.5 Console

Console equipment, unless designated otherwise, shall be rated for continuous operation under ambient environmental conditions of 36 to 122 degrees F and a relative humidity of 20 to 80 percent.

1.5 SUBMITTAL OF TECHNICAL DATA AND COMPUTER SOFTWARE

All items of computer software and technical data (including technical data which relates to computer software), which is specifically identified in this specification shall be delivered in accordance with the CONTRACT CLAUSES, SPECIAL CONTRACT REQUIREMENTS. All data delivered shall be identified by reference to the particular specification paragraph against which it is furnished.

1.5.1 Group I Technical Data Package

The data package shall include the following as required:

1.5.1.1 System Drawings

a. Functional System block diagram, identifying communications protocols, wire type and quantity, and approximate distances.

b. Security Console installation, including block and wiring diagrams and equipment layout.

c. Local processor installation, including typical block and wiring diagrams.

d. Field equipment enclosure with local processor installation and schematics.

e. Device wiring and installation drawings.

f. Details of connections to power sources, including power supplies and grounding.

g. Details of surge protection device installation.

h. Entry control system block diagram and layout.

Details of interconnections with Intercom system.

1.5.1.2 Manufacturer's Data

The data package shall include manufacturer's data for all materials and equipment, including terminal devices, local processors and central station

equipment provided under this specification.

1.6 QUALITY ASSURANCE

1.6.1 Pre-Delivery Testing

Perform pre-delivery testing, site performance verification testing, and adjustment of the completed ESS. Provide personnel, equipment, instrumentation, and supplies necessary to perform testing. Written notification of planned testing shall be given to the Government at least 14 days prior to the test; notice shall not be given until after the Contractor has received written approval of the specific test procedures.

a. Assemble the test system as specified, and perform tests to demonstrate that performance of the system complies with specified requirements in accordance with the approved predelivery test procedures. The tests shall take place during regular daytime working hours on weekdays. Model numbers of equipment tested shall be identical to those to be delivered to the site. Original copies of all data produced during predelivery testing, including results of each test procedure, shall be delivered to the Government at the conclusion of predelivery testing, prior to Government approval of the test. The test report shall be arranged so that all commands, stimuli, and responses are correlated to allow logical interpretation.

1.6.2 Test Procedures and Reports

Test procedures shall explain in detail, step-by-step actions and expected results, demonstrating compliance with the requirements specified. Test reports shall be used to document results of the tests. Reports shall be delivered to the Government within 7 days after completion of each test.

1.7 ENVIRONMENTAL REQUIREMENTS

1.7.1 Interior, Controlled Environment

System components, except the console equipment installed in interior locations, having controlled environments shall be rated for continuous operation under ambient environmental conditions of 36 to 122 degrees F dry bulb and 20 to 90 percent relative humidity, non-condensing.

1.7.2 Interior, Uncontrolled Environment

System components installed in interior locations having uncontrolled environments shall be rated for continuous operation under ambient environmental conditions of 0 to 122 degrees F dry bulb and 10 to 95 percent relative humidity, non-condensing.

1.7.3 Exterior Environment

System components that are installed in locations exposed to weather shall be rated for continuous operation under ambient environmental conditions of -30 to plus 122 degrees F dry bulb and 10 to 95 percent relative humidity, condensing. In addition, the system components shall be rated for continuous operation when exposed to performance conditions as specified in UL 294 and UL 639 for outdoor use equipment. Components shall be rated for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph and snow cover up to 2 feet thick, measured vertically.

1.8 MAINTENANCE AND SERVICE

1.8.1 Warranty Period

Provide all labor, equipment, and materials required to maintain the entire system in an operational state as specified, for a period of one year after formal written acceptance of the system to include scheduled and nonscheduled adjustments.

1.8.2 Description of Work

The adjustment and repair of the system includes all computer equipment, software updates, communications transmission equipment and DTS, local processors, sensors and entry control, facility interface, and support equipment. Responsibility shall be limited to Contractor installed equipment. Repair, calibration, and other work shall be provided and performed in accordance with the manufacturer's documentation and instruction. The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic prevention maintenance, fault diagnosis, and repair or replacement of defective components.

1.8.3 Personnel

Service personnel shall be certified in the maintenance and repair of the specific type of equipment installed and qualified to accomplish work promptly and satisfactorily. The Government shall be advised in writing of the name of the designated service representative, and of any change in personnel.

1.8.4 Schedule of Work

Perform two minor inspections at 6 month intervals (or more often if required by the manufacturer), and two major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.

1.8.4.1 Minor Inspections

Minor inspections shall include visual checks and operational tests of console equipment, peripheral equipment, local processors, sensors, and electrical and mechanical controls. Minor inspections shall also include mechanical adjustment of laser printers.

1.8.4.2 Major Inspections

Major inspections shall include work described under paragraph Minor Inspections and the following work:

a. Clean interior and exterior surfaces of all system equipment and local processors, including workstation monitors, keyboards, and console equipment.

b. Perform diagnostics on all equipment.

c. Check, walk test, and calibrate each sensor.

d. Run all system software diagnostics and correct all diagnosed problems.

e. Resolve any previous outstanding problems.

f. Purge and compress data bases.

g. Review network configuration.

1.8.4.3 Scheduled Work

Scheduled work shall be performed during regular working hours, Monday through Friday, excluding federal holidays.

1.8.5 Emergency Service

The Government will initiate service calls when the system is not functioning properly. Qualified personnel shall be available to provide service to the complete system. The Government shall be furnished with a telephone number where the service supervisor can be reached at all times. Service personnel shall be at site within 2 hours after receiving a request for service. The system shall be restored to proper operating condition within 8 hours after service personnel arrive onsite and obtain access to the system.

1.8.6 Operation

Performance verification test procedures shall be used after all scheduled maintenance and repair activities to verify proper component and system operation.

1.8.7 Records and Logs

Keep records and logs of each task, and organize cumulative records for each component, and for the complete system chronologically resulting in a continuous log to be maintained for all devices. The log shall contain all initial settings. Complete logs shall be kept and shall be available for inspection onsite, demonstrating that planned and systematic adjustments and repairs have been accomplished for the system.

1.8.8 Work Requests

Separately record each service call request, as received. The form shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the material to be used, the time and date work started, and the time and date of completion. Deliver a record of the work performed within 5 days after work is accomplished.

1.8.9 System Modifications

Make any recommendations for system modification in writing to the Government. System modifications shall not be made without prior approval of the Government. Any modifications made to the system shall result in the updating of the operation and maintenance manuals as well as any other documentation affected.

1.8.10 Software

Provide a description of all software updates to the Government, who will then decide whether or not they are appropriate for implementation. After

notification by the Government, implement the designated software updates and verify operation in the system. These updates shall be accomplished in a timely manner, fully coordinated with system operators, and shall be incorporated into the operation and maintenance manuals, and software documentation. Make a system image file so the system can be restored to its original state if the software update adversely affects system performance.

PART 2 PRODUCTS

2.1 MATERIALS REQUIREMENTS

2.1.1 Materials and Equipment

Units of equipment that perform identical, specified functions shall be products of a single manufacturer. All material and equipment shall be new and currently in production. Each major component of equipment shall have the manufacturer's model and serial number in a conspicuous place. System equipment shall conform to UL 294 and UL 1076.

2.1.2 Nameplates

Laminated plastic nameplates shall be provided for local processors. Each nameplate shall identify the local processor and its location within the system. Laminated plastic shall be 1/8 inch thick, white with black center core. Nameplates shall be a minimum of 1 x 3 inches, with minimum 1/4 inch high engraved block lettering. Nameplates shall be attached to the inside of the enclosure housing the local processor. Other major components of the system shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a corrosion resistant plate secured to the item of equipment. Nameplates will not be required for devices smaller than 1 x 3 inches.

2.1.3 Power Line Surge Protection

Equipment connected to alternating current circuits shall be protected from power line surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41.1 and IEEE C62.41.2. Fuses shall not be used for surge protection.

2.1.4 Sensor Device Wiring and Communication Circuit Surge Protection

Inputs shall be protected against surges induced on device wiring. Outputs shall be protected against surges induced on control and device wiring installed outdoors and as shown. Communications equipment shall be protected against surges induced on any communications circuit. Cables and conductors, except fiber optics, which serve as communications circuits from console to field equipment, and between field equipment, shall have surge protection circuits installed at each end. Protection shall be furnished at equipment, and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 3 feet of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 Volts and a peak current of 60 amperes.

b. An 8 microsecond rise time by 20 microsecond pulse width waveform with

a peak voltage of 1000 Volts and a peak current of 500 amperes.

2.1.5 Field Enclosures

2.1.5.1 Interior Electronics

System electronics to be used in an interior environment shall be housed in enclosures which meet the requirements of NEMA 250 Type 12.

2.1.5.2 Exterior Electronics

System electronics to be used in an exterior environment shall be housed in enclosures which meet the requirements of NEMA 250 Type 4.

2.1.5.3 Corrosion Resistant

System electronics to be used in a corrosive environment as defined in NEMA 250 shall be housed in metallic non-corrosive enclosures which meet the requirements of NEMA 250 Type 4X.

2.1.6 System Components

System components shall be designed for continuous operation. Electronic components shall be solid state type, mounted on printed circuit boards conforming to UL 796. Printed circuit board connectors shall be plug-in, quick-disconnect type. Power dissipating components shall incorporate safety margins of not less that 25 percent with respect to dissipation ratings, maximum voltages, and current carrying capacity. Control relays and similar switching devices shall be solid state type or sealed electro-mechanical.

2.1.6.1 Modularity

Equipment shall be designed for increase of system capability by installation of modular components. System components shall be designed to facilitate maintenance through replacement of modular subassemblies and parts.

2.1.6.2 Maintainability

Components shall be designed to be maintained using commercially available tools and equipment. Components shall be arranged and assembled so they are accessible to maintenance personnel. There shall be no degradation in tamper protection, structural integrity, EMI/RFI attenuation, or line supervision after maintenance when it is performed in accordance with manufacturer's instructions.

2.1.6.3 Interchangeability

The system shall be constructed with off-the-shelf components which are physically, electrically and functionally interchangeable with equivalent components as complete items. Replacement of equivalent components shall not require modification of either the new component or of other components with which the replacement items are used. Custom designed or one-of-a-kind items shall not be used. Interchangeable components or modules shall not require trial and error matching in order to meet integrated system requirements, system accuracy, or restore complete system functionality.

2.1.6.4 Product Safety

System components shall conform to applicable rules and requirements of CEC and UL 294. System components shall be equipped with instruction plates including warnings and cautions describing physical safety, and special or important procedures to be followed in operating and servicing system equipment.

2.1.7 Controls and Designations

Controls and designations shall be as specified in NEMA ICS 1.

2.1.8 Special Test Equipment

Provide all special test equipment, special hardware, software, tools, and programming or initialization equipment needed to start or maintain any part of the system and its components. Special test equipment is defined as any test equipment not normally used in an electronics maintenance facility.

2.2 ENTRY CONTROL DEVICES

2.2.1 Card Readers and Credential Cards

a. Entry control card readers shall use unique coded data stored in or on a compatible credential card as an identifier. The card readers shall be proximity type, and shall incorporate built-in heaters or other cold weather equipment to extend the operating temperature range as needed for operation at the site. Communications protocol shall be compatible with the local processor. Furnish card readers to read active proximity detection entry cards, and the matching credential cards. The cards shall contain coded data arranged as a unique identification code stored on or within the card, and of the type readable by the card readers. Include within the card's encoded data, a non-duplicated unique identification code. Enrollment equipment to support local encoding of badges including cryptographic and other internal security checks shall be supplied.

b. The encoded data shall adhere to the Government Smart Card Interoperability Specification V2.1 (GSC-IS). Any card formats that differ from the above specification must receive approval of the offered cards, readers, and data panels prior to the bid date be approved by the Government.

2.2.1.1 Magnetic Stripe

Magnetic stripe card readers shall read credential cards which meet the requirements of ISO 7810, ISO 7811-1, and ISO 7811-2. Magnetic stripe credential cards shall use single layer 4000 ersted magnetic tape material. The magnetic tape material shall be coated with Teflon and affixed to the back of the credential card near the top. The number of bits per inch, number of tracks, and number of unique codes available for the magnetic tape shall be in accordance with ISO 7811-1, and ISO 7811-2.

2.2.1.2 Weigand Wire Effect

Weigand card readers shall read credential cards which are encoded using Weigand effect ferromagnetic wires laminated into the credential card. The Weigand card reader shall create a magnetic field and output a coded

representation of the unique pattern of magnetic flux changes produced by moving the credential card through the card reader. The output shall be a series of electrical signals and shall constitute a unique identification code number. Weigand credential cards shall use at least 24 binary digits to generate a unique credential card identification code.

2.2.1.3 Smart Cards

Smart card readers shall read credential cards whose characteristics of size and technology meet those defined by ISO/IEC 7816. Smart card implementation shall adhere to the Government Smart Card Interoperability Specification (GSC-IS) and adhere to the data formats as specified by the DoD SEIWG format. The readers shall have "flash" download capability to accommodate card format changes. The card reader shall have the capability of reading the card data and transmitting the data, or a portion thereof, to the ESS control panel.

2.2.1.4 Contactless Smart Card

Smart card readers shall read credential cards whose characteristics of size and technology meet those defined by ISO/IEC 7816. Smart card implementation shall adhere to the Government Smart Card Interoperability Specification (GSC-IS) and adhere to the data formats as specified by the DoD SEIWG format. The readers shall have "flash" download capability to accommodate card format changes. The card reader shall have the capability of reading the card data and transmitting the data, or a portion thereof, to the ESS control panel.

2.2.1.5 Proximity

Proximity card readers shall use active proximity detection and shall not require contact with the proximity credential card for proper operation. Active detection proximity card readers shall provide power to compatible credential cards through magnetic induction and receive and decode a unique identification code number transmitted from the credential card. The resonant frequencies read shall constitute a unique identification code number. The card reader shall read proximity cards in a range from 0 to at least 6 inches from the reader. The credential card design shall allow for a minimum of 32,000 unique identification codes per facility.

2.2.1.6 Card Reader Display

The card readers shall include an LED or other visual indicator display. The display shall indicate power on/off, and whether user passage requests have been accepted or rejected.

2.2.1.7 Card Reader Response Time

The card reader shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 milliseconds or less, from the time the card reader finishes reading the credential card until a response signal is generated.

2.2.1.8 Card Reader Power

The card reader shall be powered from the source as shown and shall not dissipate more than 5 Watts.

2.2.1.9 Card Reader Mounting Method

Card readers shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.

2.2.1.10 Credential Card Modification

Entry control cards shall be able to be modified by lamination or direct print process during the enrollment process for use as a picture and identification badge as needed for the site without reduction of readability. The design of the credential cards shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the type badge holder used at the site.

2.2.1.11 Card Size and Dimensional Stability

Credential cards shall be 2-1/8 x 3-3/8 inches. The credential card material shall be dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.

2.2.1.12 Card Materials and Physical Characteristics

The credential card shall be abrasion resistant, non-flammable, and present no toxic hazard to humans when used in accordance with manufacturer's instructions. The credential card shall be impervious to solar radiation and the effects of ultra-violet light.

2.2.1.13 Warranty

The credential card shall include a minimum 3-year warranty.

2.2.2 Portal Control Devices

2.2.2.1 Push-button Switches

Provide momentary contact, back lighted push buttons and stainless steel switch enclosures for each push button as shown. Switch enclosures shall be suitable for flush, or surface mounting as required. Push buttons shall be suitable for flush mount in the switch enclosures. The push button switches shall meet the requirements of NEMA 250 for the area in which they are to be installed. Where multiple push buttons are housed within a single switch enclosure, they shall be stacked vertically with each push button switch labeled with 1/4 inch high text and symbols as required. The push button switches shall be connected to the local processor associated with the portal to which they are applied and shall operate the appropriate electric strike, electric bolt or other facility release device. The continuous current of the IDS circuit shall be no more than 50% of the continuous current rating of the device supplied. The push button switches shall have double-break silver contacts that will make 720 VA at 60 amperes and break 720 VA at 10 amperes.

2.2.2.2 Panic Bars: Normal Exit

a. Entry control portals shall include panic bar emergency exit hardware as scheduled in Section 08 71 00 DOOR HARDWARE. Panic bar emergency exit hardware shall provide to the portal's local processor. Operation of the panic bar hardware shall not generate an intrusion alarm. When exiting, the panic bar shall depend upon a mechanical connection only.

The non-secure side of the door shall be provided with a lever to provide access after the credential I.D. authentication by the ESS. The panic bar shall be compatible with mortise or rim mount door hardware and shall operate by retracting the bolt.

b. Signal Switches: The strikes/bolts shall include signal switches to indicate to the system when the bolt is not engaged or the strike mechanism is unlocked. The signal switches shall report a forced entry to the system.

2.2.2.3 Electrified Mortise Lock

Electrified mortise door locksc shall be designed to release automatically or remain secure in case of power failure. These facility interface devices shall use dc power to energize the solenoids. The solenoids shall be rated for continuous duty. Electric mortise locks shall incorporate end-of-line resistors to facilitate line supervision by the system. If not incorporated into the electric strike or local controller, metal-oxide veristors (MOVs) shall be installed to protect the controller from reverse current surges.

a. Solenoid: The actuating solenoid for the locks furnished shall not dissipate more than 12 Watts and shall operate on 12 or 24 Volts dc. The inrush current shall not exceed 1 ampere and the holding current shall not be greater than 700 milliamperes. The actuating solenoid shall move from the fully secure to fully open positions in not more than 500 milliseconds.

b. Signal Switches: The strikes/bolts shall include signal switches, as scheduled in Section 08 71 00 DOOR HARDWARE, to indicate to the system when the bolt is not engaged or the strike mechanism is unlocked. The signal switches shall report a forced entry to the system.

c. Hinge: An armored door cord, as scheduled in Section 08 71 00 DOOR HARDWARE, shall be provided with each lock in order to get power and monitoring signals from the lockset to the door frame.

d. Mounting Method: The electrified mortise locks shall be suitable for use with single and double door installations. In double door installations, the lock would be in the active leaf and the fixed leaf would be monitored.

2.3 ENTRY CONTROL SOFTWARE

2.3.1 Entry Control System Alarms

2.3.1.1 Strike Not Secured

The system shall annunciate an alarm when the strike at an entry controlled portal has been left unsecured longer than a predefined time delay and generate an entry control alarm. The time delay shall be adjustable, under operator control, over a range of at least 1 second to 1 minute with a maximum resolution of 1 second. The system shall have the capability of resetting the door condition based upon the door monitoring position switch indicating opening and then close.

2.3.1.2 Alarm Shunting/System Bypass

The system shall provide a means to ignore operator selected alarm types at

operator selected portals in order to allow standard entry control procedures to be bypassed (shunted). Predefined alarm shunting shall only be available to system operators with the proper password. The system shall also provide for predefined alarm shunting based upon time zones. This capability shall only apply to the entry control alarm type.

2.4 WIRE AND CABLE

Provide all wire and cable not indicated as Government furnished equipment. Wiring shall meet CEC standards.

2.4.1 Above Ground Sensor Wiring

Sensor wiring shall be 20 AWG minimum, twisted and shielded, 2, 3, 4, or 6 pairs to match hardware. Multiconductor wire shall have an outer jacket of PVC.

2.4.2 Direct Burial Sensor Wiring

Sensor wiring shall be 20 AWG minimum, twisted and shielded, 2, 3, 4, or 6 pairs to match hardware.

2.4.3 Local Area Network (LAN) Cabling

LAN cabling shall be in accordance with TIA-568-C.1, category 5.

2.4.4 Cable Construction

All cable components shall withstand the environment in which the cable is installed for a minimum of 20 years.

2.4.5 Power Line Surge Protection

Equipment connected to alternating current circuits shall be protected from power line surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41.1 and IEEE C62.41.2. Fuses shall not be used for surge protection.

PART 3 EXECUTION

3.1 EXAMINATION

Verify that site conditions are in agreement with the design package and report any changes in the site, or conditions that will affect performance of the system to the Government in a report as defined in paragraph Group II Technical Data Package. Do not take any corrective action without written permission from the Government.

3.2 GENERAL REQUIREMENTS

Install all system components, including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown. Furnish necessary interconnections, services, and adjustments required for a complete and operable system as specified and shown. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

3.2.1 Installation

Install the system in accordance with the standards for safety, CEC, UL 681, UL 1037 and UL 1076, and the appropriate installation manual for each equipment type. Components within the system shall be configured with appropriate service points to pinpoint system trouble in less than 20 minutes. Conduit shall be rigid galvanized steel or as shown and a minimum of 1/2 inch in diameter. DTS shall not be pulled into conduits or placed in raceways, compartments, outlet boxes, junction boxes, or similar fittings with other building wiring. Flexible cords or cord connections shall not be used to supply power to any components of the system, except where specifically noted. All other electrical work shall be as specified in Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL and as shown.

3.2.2 Enclosure Penetrations

Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in a manner that does not damage the cable.

3.2.3 Cold Galvanizing

Field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc., shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.2.4 Existing Equipment

Connect to and utilize existing equipment, DTS, and devices as shown. System equipment and DTS that are usable in their original configuration without modification may be reused with Government approval. Perform a field survey, including testing and inspection of all existing system equipment and DTS intended to be incorporated into the system, and furnish a report to the Government as part of the site survey report as defined in paragraph Group II Technical Data Package. For those items considered nonfunctioning, the report shall include specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, include the scheduled need date for connection to all existing equipment. Make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Government approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, diagnose the failure and perform any necessary corrections to the equipment and work. The Government is responsible for maintenance and the repair of Government equipment. The Contractor is responsible for repair costs due to negligence or abuse of Government equipment.

3.3 SYSTEM STARTUP

Satisfaction of the requirements below does not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment. Do not apply power to the system until after:

a. System equipment items and DTS have been set up in accordance with manufacturer's instructions.

b. A visual inspection of the system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

c. System wiring has been tested and verified as correctly connected.

d. System grounding and transient protection systems have been verified as properly installed.

e. Power supplies to be connected to the system have been verified as the correct voltage, phasing, and frequency.

3.4 SUPPLEMENTAL CONTRACTOR QUALITY CONTROL

Provide the services of technical representatives who are familiar with all components and installation procedures of the installed system; and are approved by the COR. These representatives shall be present on the job site during the preparatory and initial phases of quality control to provide technical assistance. These representatives shall also be available on an as needed basis to provide assistance with follow-up phases of quality control. These technical representatives shall participate in the testing and validation of the system and shall provide certification that their respective system portions meet the contractual requirements.

3.5 TESTING

3.5.1 General Requirements for Testing

Provide personnel, equipment, instrumentation, and supplies necessary to perform site testing. The Government will witness all performance verification and endurance testing. Written permission shall be obtained from the Government before proceeding with the next phase of testing. Original copies of all data produced during predelivery, performance verification and endurance testing, shall be turned over to the Government at the conclusion of each phase of testing, prior to Government approval of the test.

3.5.2 Contractor's Field Testing

Calibrate and test all equipment, verify DTS operation, place the integrated system in service, and test the integrated system. Test installed ground rods as specified in IEEE 142. Deliver a report describing results of functional tests, diagnostics, and calibrations, including written certification to the Government that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. It is recommended that the Contractor use the approved performance verification test as a guideline when the field test is conducted.

3.5.3 Performance Verification Test

Demonstrate that the completed system complies with the contract requirements. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The performance verification test, as specified, shall not be started until

after receipt by the Contractor of written permission from the Government, based on the Contractor's written report. The report shall include certification of successful completion of testing as specified in paragraph Contractor's Field Testing, and upon successful completion of training as specified. The Government may terminate testing at any time when the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, commence an assessment period as described for Endurance Testing Phase II. Upon successful completion of the performance verification test, deliver test reports and other documentation as specified to the Government prior to commencing the endurance test.

3.5.4 Endurance Test

a. General: Demonstrate system reliability and operability at the specified throughput rates for each portal, and the Type I and Type II error rates specified for the completed system. Calculate false alarm rates and the system shall yield false alarm rates within the specified maximums at the specified probability of detection. The endurance test shall be conducted in phases as specified. The endurance test shall not be started until the Government notifies the Contractor, in writing, that the performance verification test is satisfactorily completed, training as specified has been completed, and correction of all outstanding deficiencies has been satisfactorily completed. Provide 1 operator to operate the system 24 hours per day, including weekends and holidays, during Phase I and Phase III endurance testing, in addition to any Government personnel that may be made available. The Government may terminate testing at any time the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, commence an assessment period as described for Phase II. Verify the operation of each terminal device during the last day of the test. Upon successful completion of the endurance test, deliver test reports and other documentation as specified to the Government prior to acceptance of the system.

b. Phase I Testing: The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. Make no repairs during this phase of testing unless authorized by the Government in writing. If the system experiences no failures during Phase I testing, the Contractor may proceed directly to Phase III testing after receipt of written permission from the Government.

c. Phase II Assessment: After the conclusion of Phase I, identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, convene a test review meeting at the jobsite to present the results and recommendations to the Government. The meeting shall not be scheduled earlier than 5 business days after receipt of the report by the Government. As a part of this test review meeting, demonstrate that all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Government will determine the restart date, or may require that Phase I be repeated. If the retest is completed without any failures, the Contractor may proceed directly to Phase III testing after receipt of written permission from the Government.

d. Phase III Testing: The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. Make no repairs during this phase of testing unless authorized by the Government in writing.

e. Phase IV Assessment: After the conclusion of Phase III, identify all failures, determine causes of failures, repair failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, convene a test review meeting at the jobsite to present the results and recommendations to the Government. The meeting shall not be scheduled earlier than 5 business days after receipt of the report by the Government. As a part of this test review meeting, demonstrate that all failures have been corrected by repeating appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Government will determine the restart date, and may require that Phase III be repeated. Do not commence any required retesting until after receipt of written notification by Government. After the conclusion of any retesting which the Government may require, the Phase IV assessment shall be repeated as if Phase III had just been completed.

f. Exclusions: The Contractor will not be held responsible for failures in system performance resulting from the following:

1. An outage of the main power in excess of the capability of any backup power source, provided that the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the ESS performed as specified.

2. Failure of a Government furnished communications circuit, provided that the failure was not due to Contractor furnished equipment, installation, or software.

3. Failure of existing Government owned equipment, provided that the failure was not due to Contractor furnished equipment, installation, or software.

4. The occurrence of specified nuisance alarms.

5. The occurrence of specified environmental alarms.

-- End of Section --

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SECTION 31 00 00

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SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

This section covers earthwork activities for buildings, utilities, roadways, railroads, and airfields.

1.2 PAYMENT PROCEDURES

Payment will constitute full compensation for all labor, equipment, tools, supplies, and incidentals necessary to complete the work.

1.2.1 Classified Excavation

Classified excavation will be paid for at the contract unit prices per cubic yard for common or rock excavation.

1.2.2 Piping Trench Excavation

Payment for trench excavation will constitute full payment for excavation and backfilling, including specified overdepth except in unstable trench bottoms.

1.2.3 Unclassified Excavation

Unclassified excavation will be paid for at the contract unit price per cubic yard for unclassified excavation.

1.3 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C2	Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA P5	Standard for Waterborne Preservatives

ASTM INTERNATIONAL (ASTM)

ASTM A139/A139M	Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A252	Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C33/C33M	Standard Specification for Concrete Aggregates
ASTM D 1140	Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 2487	Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 422	Particle-Size Analysis of Soils
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D 4718	Standard Practice for Correction of Unit and Water Content for Soils Containing Oversize Weight Particles

1.5 DEFINITIONS

1.5.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SC, CL, ML, CH, MH. Satisfactory materials for grading comprise stones less than 8 inches, except for fill material for pavements and railroads which comprise stones less than 3 inches in any dimension.

1.5.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the COR when encountering any contaminated materials.

1.5.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D 4318, ASTM C136, ASTM D 422, and ASTM D 1140.

1.5.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with ASTM D 4718corrected with ASTM D 4718.

1.5.5 Topsoil

Material suitable for topsoils obtained from areas indicated on the drawings is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.5.6 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.5.7 Select Granular Material

1.5.7.1 General Requirements

Select granular material consist of materials classified as GW, GP by

ASTM D 2487 where indicated. The liquid limit of such material must not exceed 35 percent when tested in accordance with ASTM D 4318. The plasticity index must not be greater than 12 percent when tested in accordance with ASTM D 4318, and not more than 35 percent by weight may be finer than No. 200 sieve when tested in accordance with ASTM D 1140.

1.5.7.2 California Bearing Ratio Values

1.5.8 Initial Backfill Material

Initial backfill consists of select granular material or satisfactory materials free from rocks of such size as recommended by the pipe manufacturer.

1.5.9 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 25 when tested in accordance with ASTM D 4318.

1.5.10 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.6 SYSTEM DESCRIPTION

Subsurface soil boring logs are shown in the NASA Ames SVS Boiler Plant Geotechnical Investigation report, dated May 2011. The geotechnical investigation report shall be provided upon request by the COR. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.6.1 Classification of Excavation

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.6.2 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.7 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring
Dewatering Work Plan

SD-03 Product Data

Utilization of Excavated Materials

Opening of any Excavation or Borrow Pit
Shoulder Construction

SD-06 Test Reports

Testing
Borrow Site Testing

SD-07 Certificates

Testing

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for the chemicals listed in the following table.

Compounds	EPA Test Methods
Total Petroleum Hydrocarbons (including Benzene, Toluene, Ethylbenzene, Xylenes)	8015M
Volatile Organic Compounds	8260B/624
Metals	6010/6020/7000
Pesticides	8081A
PCBs (including Aroclor	1268) 8082A

Provide Borrow Site Testing for listed compounds from a composite sample of material from the borrow site, with at least one test from each borrow site. Within 24 hours of conclusion of physical tests, submit 3 copies of test results including lab QC reports to the COR. Do not bring material onsite until tests have been approved by the Contracting Officer.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

Provide polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inches minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes

Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air

2.2.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inch and a minimum strength of 1500 psi lengthwise, and

1250 psi crosswise, with a maximum 350 percent elongation.

2.2.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3 DETECTION WIRE FOR NON-METALLIC PIPING

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.4 CAPILLARY WATER BARRIER

Provide capillary water barrier of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below. Conform to ASTM C33/C33M for fine aggregate grading with a maximum of 3 percent by weight passing ASTM D 1140, No. 200 sieve, .

2.5 PIPE CASING

2.5.1 Casing Pipe

ASTM A139/A139M, Grade B, or ASTM A252, Grade 2, smooth wall pipe. Match casing size to the outside diameter and wall thickness as indicated on Drawings. Protective coating is not required on casing pipe.

2.5.2 Wood Supports

Locally available, rough, structural grade. Provide wood with nonleaching water-borne pressure preservative (ACA or CCA) and treatment conforming to AWPA P5 and AWPA C2, respectively. Secure wood supports to carrier pipe with stainless steel or zinc-coated steel bands.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of 4 inches. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Remove from the site any surplus of topsoil from excavations and gradings.

3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as

specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown on drawings. Do not excavate ditches and gutters below grades shown. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed, except in no case allow material be deposited a maximum 4 feet from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed. Where pile foundations are to be used, stop the excavation of each pit at an elevation 1 foot above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, remove loose and displaced material and complete excavation, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.

3.2.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to

proceed.

3.2.4 Dewatering

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, maintain the water level continuously, at least 3 feet below the working level. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly.

3.2.5 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls more than 5 feet high, cut back to a stable slope, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in. Shore vertical trench walls soilin accordance with OSHA regulations. Give special attention to slopes which may be adversely affected by weather or moisture content.

3.2.5.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones as recommended by the pipe manufacturer to avoid point bearing.

3.2.5.2 Removal of Unyielding Material

Where overdepth is not indicated and unyielding material such as concrete, is encountered in the bottom of the trench, remove such material 12 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.5.3 Removal of Unstable Material

Where unstable material is encounteredsuch as
concrete, in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.2.5.4 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar

structures of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Remove loose disintegrated rock and thin strata. Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.2.5.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, provide excavation by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the COR, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.2.6 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the COR. Report damage to utility lines or subsurface construction immediately to the COR.

3.2.7 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the COR prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the COR. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of ASTM D 698 maximum density.

3.3 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from the borrow areas shown on Drawings. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITSAND BORROW PITS

Except as otherwise permitted, excavate borrow pits and other excavation areas providing adequate drainage. Transport overburden and other spoil

material to designated spoil areas or otherwise dispose of as directed. Provide neatly trimmed and drained borrow pits after the excavation is completed. Ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 SHORING

3.5.1 General Requirements

Submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheeting as excavations are backfilled, in a manner to prevent caving.

3.5.2 Geotechnical Engineer

Hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer is responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer is responsible for updating the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and submit an updated plan if necessary. Submit a monthly written report, informing the Contractor and COR of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The COR is responsible for arranging meetings with the Geotechnical Engineer at any time throughout the contract duration.

3.6 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory and unsatisfactory as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.7 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. For pile foundations, stop the excavation at an elevation of from 6 to 12 inches above the bottom of the footing before driving piles. After pile driving has been completed, complete the remainder of the excavation to the elevations shown.

3.8 GROUND SURFACE PREPARATION

3.8.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the COR, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

3.9 UTILIZATION OF EXCAVATED MATERIALS

Dispose unsatisfactory materials removing from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Submit procedure and location for disposal of unused satisfactory material. Submit proposed source of borrow material. Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed. Clear and grub newly designated waste areas on Government-controlled land before disposal of waste material thereon. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.10 BURIED TAPE AND DETECTION WIRE

3.10.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.10.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over it's entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

3.11 BACKFILLING AND COMPACTION

Place backfill adjacent to any and all types of structures, and compact to at least 90 percent laboratory maximum density for cohesive materials or 95

percent laboratory maximum density for cohesionless materials, to prevent wedging action or eccentric loading upon or against the structure. Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.11.1 Trench Backfill

Backfill trenches to the grade shown. Do not backfill the trench until all specified tests are performed.

3.11.1.1 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inches loose thickness.

3.11.1.2 Bedding and Initial Backfill

Provide bedding of the type and thickness shown. Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Compact backfill to top of pipe to 90 percent of ASTM D 1557 maximum density. Provide plastic piping with bedding to spring line of pipe. Provide materials as follows:

a. Class I: Angular, 0.25 to 1.5 inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inch, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

c. Clean, coarse-grained sand classified as SW or SP by ASTM D 2487 for bedding and backfill as indicated.

d. Clean, coarsely graded natural gravel, crushed stone or a combination thereof identified as having a classification of GW in accordance with ASTM D 2487 for bedding and backfill as indicated. Do not exceed maximum particle size of 3 inches.

3.11.1.3 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, railroads and airfields, with satisfactory material. Place backfill material and compact as follows:

a. Roadways, Railroads, and Airfields: Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Deposit backfill in layers of a maximum of 12 inches loose thickness, and compact it to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Do not permit compaction by water flooding or jetting. Apply this requirement to all other areas not specifically designated above.

3.11.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed , place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.12 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.12.1 Gas Distribution

Excavate trenches to a depth that will provide a a minimum 24 inch of cover in other excavation.

3.12.2 Water Lines

Excavate trenches to a depth that provides a minimum cover of 3 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.12.3 Heat Distribution System

Free initial backfill material of stones larger than 1/4 inch in any dimension.

3.12.4 Electrical Distribution System

Provide a minimum cover of 24 inches from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.12.5 Sewage Absorption Trenches or Pits

3.12.5.1 Porous Fill

Provide backfill material consisting of clean crushed rock or gravel having a gradation such that 100 percent passes the 2 inch sieve and zero percent passes the 1/2 inch sieve. conforming to the requirements of gradation No. 4 for coarse aggregate in ASTM C33/C33M.

3.12.5.2 Cover

Filter fabric as indicated.

3.12.6 Pipeline Casing

Provide new smooth wall steel pipeline casing under existing structures.

Provide each new pipeline casing, where indicated and to the lengths and dimensions shown, complete and suitable for use with the new piped utility as indicated. Install pipeline casing by dry boring and jacking method as follows:

3.12.6.1 Bore Holes

Mechanically bore holes and case through the soil with a cutting head on a continuous auger mounted inside the casing pipe. Weld lengths of pipe together in accordance with AWS D1.1/D1.1M. Do not use water or other fluids in connection with the boring operation.

3.12.6.2 Cleaning

Clean inside of the pipeline casing of dirt, weld splatters, and other foreign matter which would interfere with insertion of the piped utilities by attaching a pipe cleaning plug to the boring rig and passing it through the pipe.

3.12.6.3 End Seals

After installation of piped utilities in pipeline casing, provide watertight end seals at each end of pipeline casing between pipeline casing and piping utilities. Provide watertight segmented elastomeric end seals.

3.13 EMBANKMENTS

3.13.1 Earth Embankments

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 12 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise brake up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.14 SUBGRADE PREPARATION

3.14.1 Proof Rolling

Finish proof rolling on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After compacting, proof roll the existing subgrade with several passes of a or a fully loaded water truck or a 15 ton, pneumatic-tired roller. Operate the roller and truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2-1/2 to 3-1/2 mph. When proof rolling, provide one-half of the passes made with the roller in a direction perpendicular to the other passes. Notify the COR a minimum of 3 days prior to proof rolling. Perform proof rolling in the presence of the COR. Undercut rutting or pumping of

material as directed by the COR and replace with fill and backfill select material.

3.14.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 1/2 inch when tested with a 12-foot straightedge applied both parallel and at right angles to the centerline of the area. Do not vary the elevation of the finish subgrade more than 0.05 foot from the established grade and cross section.

3.14.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, compact each layer of the embankment to at least 90 percent of laboratory maximum density(ASTM D 1557).

3.14.3.1 Subgrade for Railroads

Compact subgrade for railroads to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials.

3.14.3.2 Subgrade for Pavements

Compact subgrade for pavements to at least 95 percentage laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top 6 inch of subgrade.

3.14.3.3 Subgrade for Shoulders

Compact subgrade for shoulders to at least 95 percentage laboratory maximum density for the depth below the surface of shoulder shown.

3.15 SHOULDER CONSTRUCTION

Construct shoulders of satisfactory excavated or borrow material or as otherwise shown or specified.. Submit advanced notice on shoulder construction for rigid pavements. Construct shoulders immediately after adjacent paving is complete. In the case of rigid pavements, do not construct shoulders until permission of the COR has been obtained. Compact the entire shoulder area to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish shoulder construction in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. Align the completed shoulders true to grade and shaped

to drain in conformity with the cross section shown.

3.16 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.16.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.16.2 Capillary Water Barrier

Place a capillary water barrier under concrete floor and area-way slabs grade directly on the subgrade and compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.16.3 Grading Around Structures

Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.17 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 2 inches depth for bonding of topsoil with subsoil. Spread topsoil evenly and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from areas indicated.

3.18 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. Submit qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the COR.

a. Determine field in-place density in accordance with ASTM D 6938.

b. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.18.1 Fill and Backfill Material Gradation

One test per 1000 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM D 422 .

3.18.2 In-Place Densities

a. One test per 2,500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 10,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

c. One test per 200 linear feet, or fraction thereof, of each lift of embankment or backfill for roads.

d. One test per 200 linear feet, or fraction thereof, of each lift of embankment or backfill for railroads.

3.18.3 Moisture Contents

In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the COR.

3.18.4 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 500 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.18.5 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.18.6 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the COR. Inspect pipe sizes larger than 36 inches, while inspecting smaller diameter pipe by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the COR, the interior of the pipe

shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

3.19 DISPOSITION OF SURPLUS MATERIAL

Provide surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber as removed from Government property as directed by the COR.

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SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SUMMARY

This section covers clearing and grubbing.

1.2 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Nonsaleable Materials

SD-04 Samples

Tree wound paint
Herbicide

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to store at the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

PART 2 PRODUCTS

2.1 TREE WOUND PAINT

Submit samples in cans with manufacturer's label of bituminous based paint of standard manufacture specially formulated for tree wounds.

2.2 HERBICIDE

QuickPro Dry Herbacide. Comply with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7 U.S.C. Section 136) for requirements on Contractor's licensing, certification and record keeping. Contact the command Pest Control Coordinator prior to starting work. Submit samples in cans with manufacturer's label.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.2 Trees, Shrubs, and Existing Facilities

3.1.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the COR immediately of damage to or an encounter with an unknown existing utility line. The Contractor is responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, notify the COR in ample time to minimize interruption of the service. Refer to Section 01 30 00, ADMINISTRATIVE REQUIREMENTS and Section 01 57 19.00 20, TEMPORARY ENVIRONMENTAL CONTROLS for additional utility protection.

3.2 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint. Apply herbicide in accordance with the manufacturer's label to the top surface of stumps designated not to be removed.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.5 DISPOSAL OF MATERIALS

3.5.1

Written permission to dispose of such products on private property shall be filed with the COR. Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

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EXCAVATION AND FILL

PART 1 GENERAL

1.1 SUMMARY

This section covers earthwork requirements for buildings, roads, and utilities.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 33/C 33M	Standard Specification for Concrete Aggregates
ASTM D 1140	Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 2216	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2487	Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4355	Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D 4491	Water Permeability of Geotextiles by Permittivity
ASTM D 4533	Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	Determining Apparent Opening Size of a Geotextile
ASTM D 4759	Determining the Specification Conformance of Geosynthetics
ASTM D 4833	Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D 698	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	Safety and Health Requirements Manual

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 530/F-93/004	Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 600/4-79/020	Methods for Chemical Analysis of Water and Wastes

1.3 DEFINITIONS

1.3.1 Capillary Water Barrier

A layer of clean, poorly graded crushed rock, stone, or natural sand or gravel having a high porosity which is placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below a slab.

1.3.2 Degree of Compaction

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 698, for general soil

types, abbreviated as percent laboratory maximum density.

1.3.3 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.3.4 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.3.5 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Dewatering work plan

Submit 15 days prior to starting work.

SD-06 Test Reports

Borrow Site Testing

Fill and backfill test

Select material test

Porous fill test for capillary water barrier

Density tests

Moisture Content Tests

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

1.5 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.6 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

d. Material character is indicated by the boring logs.

e. Blasting will not be permitted. Remove material in an approved manner.

f. Blasting will be permitted. Blasting shall be conducted in accordance with EM 385-1-1, and Federal, State, and local safety regulations. Submit for approval a blasting plan, including calculations for overpressure and debris hazard, prepared and sealed by a registered professional engineer. Blasting mats shall be provided, and non-electric blasting caps shall be used. Notify the COR 24 hours prior to blasting.

1.7 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCPL test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA 530/F-93/004 Method 5030/8020. TCLP shall be performed in accordance with EPA 530/F-93/004 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by the COR.

1.8 QUALITY ASSURANCE

1.8.1 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the COR. Report damage to utility lines or subsurface construction immediately to the COR.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

2.1.1 Satisfactory Materials

Any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 25 inches. The COR shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

2.1.4 Expansive Soils

Soils that have a plasticity index are identified in GEOTECHNICAL INVESTIGATION NASA AMES SVS BOILER PLANT PROJECT MAY 2011.

2.1.5 Nonfrost Susceptible (NFS) Material

A uniformly graded washed sand with a maximum particle size of 0/02 inch and less than 5 percent passing the No. 200 size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

2.1.6 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.7 Backfill and Fill Material

ASTM D 2487, classification GW, GP, GM, SW, SP, SM, with a maximum ASTM D 4318 liquid limit of 35 , maximum ASTM D 4318 plasticity index of 12 and a maximum of 25 percent by weight passing ASTM D 1140, No. 200 sieve.

2.1.8 Select Material

Provide materials classified as GW, GP, SW, SP, or SM by ASTM D 2487 where indicated. The liquid limit of such material shall not exceed 35 percent when tested in accordance with ASTM D 4318. The plasticity index shall not be greater than 12 percent when tested in accordance with ASTM D 4318, and

not more than 35 percent by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D 1140.

Sieve Size	Percent Passing by Weight
2 1/2 inches	100
No. 4	40 - 85
No. 10	20 - 80
No. 40	10 - 60
No. 200	5 - 25

2.1.9 Topsoil

Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

2.2 POROUS FILL FOR CAPILLARY WATER BARRIER

ASTM C 33/C 33M fine aggregate grading with a maximum of 3 percent by weight passing ASTM D 1140, No. 200 sieve, or 1-1/2 inches and no more than 2 percent by weight passing the No. 4 size sieve or coarse aggregate Size 57, 67, or 77 and conforming to the general soil material requirements specified in paragraph entitled "Satisfactory Materials."

2.3 UTILITY BEDDING MATERIAL

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide ASTM D 2321 materials as follows:

a. Class I: Angular, 0.25 to 1.5 inches, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

2.3.1 Sand

Clean, coarse-grained sand classified as ASTM C33 or by ASTM D 2487 for bedding as indicated.

2.3.2 Gravel

Clean, coarsely graded natural gravel, crushed stone or a combination thereof or having a classification of GW GP in accordance with ASTM D 2487 for bedding and as indicated.

2.4 BORROW

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property.

2.5 FILTER FABRIC

Provide a pervious sheet of polyester, nylon, glass or polypropylene filaments woven, spun bonded, fused, or otherwise manufactured into a nonraveling fabric with uniform thickness and strength. Fabric shall have the following manufacturer certified minimum average roll properties as determined by ASTM D 4759:

		Class A	Class B	
a.	Grab tensile strength (ASTM D 4632) machine and transversed direction	min. 180	80	lbs.
b.	Grab elongation (ASTM D 4632) machine and transverse direction	min. 15	15	percent
c.	Puncture resistance (ASTM D 4833)	min. 80	25	lbs.
d.	Mullen burst strength (ASTM D 3786 /D 3786M)	min. 290	130	psi.
e.	Trapezoidal Tear (ASTM D 4533)	min. 50	25	lbs.
f.	Apparent Opening Size (ASTM D 4751)	See Criteria Below		
	1. Soil with 50 percent or less particles by weight passing US No. 200 Sieve, AOS less than 0.6 mm (greater than #30 US Std. Sieve)			
	2. Soil with more than 50 percent particles by weight passing US No. 200 Sieve, AOS less than 0.297 mm (greater than #50 US Std. Sieve)			
g.	Permeability (ASTM D 4491)	k fabric greater than k Soil		
h.	Ultraviolet Degradation (ASTM D 4355)	70 percent Strength retained at 150 hours		

2.6 MATERIAL FOR RIP-RAP

For construction indicated.

2.6.1 Bedding Material

Consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 2 inches. Material shall be composed of tough, durable particles. Fines passing the No. 200 standard sieve shall have a plasticity index less than six.

2.7 BURIED WARNING AND IDENTIFICATION TAPE

Warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing

shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Yellow:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air

2.7.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.7.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.8 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Shoring and Sheeting

Provide shoring where indicated. In addition to Section 25 A and B of EM 385-1-1 , include provisions in the shoring and sheeting plan that will accomplish the following:

a. Prevent undermining of pavements, foundations and slabs.

b. Prevent slippage or movement in banks or slopes adjacent to the excavation.

3.1.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.1.2.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials

sufficiently dry. The Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.1.2.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 3 feet feet below the working level.

Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly. Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system.

3.1.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall contact the Public Works Department for assistance in locating existing utilities. The Contractor shall scan the construction site with electromagnetic and sonic equipment and mark the surface of the ground where existing underground utilities are discovered.

3.1.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.2 SURFACE PREPARATION

3.2.1 Clearing and Grubbing

Unless indicated otherwise, remove trees, stumps, logs, shrubs, brush and vegetation and other items that would interfere with construction

operations within the clearing limits . Remove stumps entirely. Grub out matted roots and roots over 2 inches in diameter to at least 18 inches below existing surface.

3.2.2 Stripping

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be stockpiled and used for backfilling. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

3.2.3 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with backfill and fill material and compact to 95 percent of ASTM D 698 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with backfill and fill material and compact to 95 percent of ASTM D 698 maximum density. Satisfactory material removed below the depths indicated, without specific direction of the COR, shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the COR.

3.3.1 Structures With Spread Footings

Ensure that footing subgrades have been inspected and approved by the COR prior to concrete placement. Fill over excavations with concrete during foundation placement.

3.3.2 Pile Cap Excavation and Backfilling

Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the COR. Backfill and compact overexcavations and changes in grade due to pile driving operations to 95 percent of ASTM D 698 maximum density.

3.3.3 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported

for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe.

3.3.4 Hard Material and Rock Excavation

Remove hard material and rock to elevations indicated in a manner that will leave foundation material in an unshattered and solid condition. Roughen level surfaces and cut sloped surfaces into benches for bond with concrete. Protect shale from conditions causing decomposition along joints or cleavage planes and other types of erosion. Removal of hard material and rock beyond lines and grades indicated will not be grounds for a claim for additional payment unless previously authorized by the COR. Excavation of the material claimed as rock shall not be performed until the material has been cross sectioned by the Contractor and approved by the COR. Common excavation shall consist of all excavation not classified as rock excavation.

3.3.5 Excavated Materials

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.3.6 Final Grade of Surfaces to Support Concrete

Excavation to final grade shall not be made until just before concrete is to be placed. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

3.4 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the COR. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary . Minimum subgrade density shall be as specified herein.

3.4.1 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of

an otherwise acceptable subgrade. proof roll the existing subgrade of the building with six passes of a dump truck loaded with 212 cubic feet of soil Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2 1/2 to 3 1/2 miles per hour. When proof rolling under buildings, the building subgrade shall be considered to extend 5 feet beyond the building lines, and one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Notify the COR a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the COR. Rutting or pumping of material shall be undercut as directed by the COR and replaced with fill and backfill material.

3.5 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.5.1 Common Fill Placement

Provide for general site . Place in 6 inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.5.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in 6 inch lifts. Do not place over wet or frozen areas. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.5.3 Select Material Placement

Provide under structures not pile supported. Place in 6 inch lifts. Do not place over wet or frozen areas. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structure.

3.5.4 Backfill and Fill Material Placement Over Pipes and at Walls

Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade . Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable,

backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

3.5.5 Porous Fill Placement

Provide under floor and area-way slabs on a compacted subgrade. Place in 4 inch lifts with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.5.6 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 6 inch lifts to top of trench and in 6 inch lifts to one foot over pipe outside structures and paved areas.

3.6 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved borrow materials shall be obtained as specified herein.

3.7 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.8 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.9 COMPACTION

Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required. Density requirements specified herein are for cohesionless materials. When cohesive materials are encountered or used, density requirements may be reduced by 5 percent.

3.9.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5 foot line of the paved area or structure to 85 percent of ASTM D 698 .

3.9.2 Structures, Spread Footings, and Concrete Slabs

Compact top 12 inches of subgrades to 95 percent of ASTM D 698 . Compact fill and backfill material to 95 percent of ASTM D 698 .

3.9.3 Adjacent Area

Compact areas within 5 feet of structures to 90 percent of ASTM D 698 .

3.9.4 Paved Areas

Compact top 12 inches of subgrades to 95 percent of ASTM D 698 . Compact fill and backfill materials to 95 percent of ASTM D 698 .

3.10 FINISH OPERATIONS

3.10.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.10.2 Protection of Surfaces

Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.11 DISPOSITION OF SURPLUS MATERIAL

Waste in Government disposal area indicated surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber.

3.12 FIELD QUALITY CONTROL

3.12.1 Sampling

Take the number and size of samples required to perform the following tests.

3.12.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.12.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 4318 for liquid limit and for plastic limit; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.12.2.2 Select Material Testing

Test select material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.12.2.3 Porous Fill Testing

Test porous fill in accordance with ASTM C 136 for conformance to gradation specified in ASTM C 33/C 33M.

3.12.2.4 Density Tests

Test density in accordance with ASTM D 1556, or ASTM D 6938. When ASTM D 6938 density tests are used, verify density test results by performing an ASTM D 1556 density test at a location already ASTM D 6938 tested as specified herein. Perform an ASTM D 1556 density test at the start of the job, and for every 10 ASTM D 6938 density tests thereafter. Test each lift at randomly selected locations every 2000 square feet of existing grade in fills for structures and concrete slabs, and every 2500 square feet for other fill areas and every 2000 square feet of subgrade in cut. Include density test results in daily report.

Bedding and backfill in trenches: One test per 50 linear feet in each lift.

3.12.2.5 Moisture Content Tests

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D 2216. Include moisture content test results in daily report.

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SECTION 31 60 00

FOUNDATION PREPARATION

PART 1 GENERAL

1.1 SUMMARY

This section covers embankments and concrete structures placed on rock foundations, including all operations on the rock surface to make that surface acceptable for the placement of embankment or concrete.

1.2 UNIT PRICES

1.2.1 Preliminary Cleanup

1.2.1.1 Payment

Payment will be made for costs for each preliminary cleanup satisfactorily performed at the direction of the COR. Payment will be made for each cleanup of the same area if more than one cleanup has been directed and satisfactorily performed.

1.2.1.2 Measurement

Preliminary cleanup will be measured for payment by determining the area cleaned to the nearest square yard.

1.2.1.3 Unit of Measure

Unit of measure: square yard.

1.2.2 Final Cleanup

1.2.2.1 Payment

Payment will be made for costs associated with final cleanup of the area for each type of foundation preparation that has been satisfactorily prepared. Where preliminary cleanup has been directed and performed and the Contractor subsequently performs final cleanup, payment will be made for preliminary cleanup. Payment will not be made for any cleanup subsequent to final cleanup.

1.2.2.2 Measurement

Final cleanup will be measured for payment by determining the area cleaned to the nearest square yard.

1.2.2.3 Unit of measure

Square yard.

1.2.3 Foundation Preparation

1.2.3.1 Payment

Payment will be made for costs associated with foundation preparation of the area for each type of foundation preparation that has been satisfactorily prepared. Where preliminary cleanup has been directed and performed and the Contractor subsequently performs foundation preparation, payment will be made for foundation preparation. Payment will not be made for more than one foundation preparation of the same area.

1.2.3.2 Measurement

Foundation preparation will be measured for payment by determining the area prepared to the nearest square yard.

1.2.3.3 Unit of measure

Square yard.

1.2.4 Dental Concrete

1.2.4.1 Payment

Payment will be made for costs associated with dental concrete placed.

1.2.4.2 Measurement

Dental concrete will be measured for payment by determining the volume to the nearest one-tenth cubic yard.

1.2.4.3 Unit of measure

Cubic yard.

1.2.5 Dental Mortar

1.2.5.1 Payment

Payment will be made for costs associated with dental mortar placed.

1.2.5.2 Measurement

Dental mortar will be measured for payment by determining the volume to the nearest one-tenth cubic yard.

1.2.5.3 Unit of measure

Cubic yard.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM A185/A185M	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM C 270	Standard Specification for Mortar for Unit Masonry
ASTM C 387/C 387M	Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete

1.4 DEFINITIONS

1.4.1 Foundations

The rock foundation is comprised of the rock surfaces upon which concrete structures are placed. Vertical surfaces, where permitted or required by these specifications, are included.

1.4.2 Rock Joints

Rock joints are all planar and/or curvilinear fractures, including cracks, crevices, and seams which separate a rock mass into individual rock blocks of various sizes. They may be open or closed and may be filled with material other than rock material.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Tools

Tabular list of light power tools to be used in lieu of hand tools, for approval prior to their use on the job site.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Dental Concrete

Dental concrete shall conform to the requirements of ASTM C 387/C 387M, normal weight and strength.

2.1.2 Dental Mortar

Dental mortar shall conform with ASTM C 270 or ASTM C 387/C 387M, Type N.

2.1.3 Welded Wire Fabric

Welded wire fabric used shall be 6 by 6 inches - W3 x W3, conforming to ASTM A185/A185M.

2.1.4 Filter Material

Filter material shall consist of sand and gravel and crushed stone. for filter materials shall meet the applicable requirements of

PART 3 EXECUTION

3.1 EXAMINATION

The limits of the proposed foundations for the various parts of the work are approximately as indicated. The COR reserves the right to change the depth to, or the width of, the foundations if, conditions exposed in the foundation excavations, or as determined by exploratory drilling, warrant such modifications.

3.2 PREPARATION

3.2.1 Equipment

3.2.1.1 Tools

Hand tools, where required or permitted by these specifications include, but are not limited to shovels, bars, picks, wedges, and brooms. Light power tools may be used in lieu of hand tools only when such use is approved.

3.2.1.2 Water Jet

A water jet shall consist of a 1 inch nozzle with a supply hose connected to a suitable source of water. The system shall be capable of delivering up to 200 gpm. The flow rate shall be controllable at the nozzle.

3.3 PRELIMINARY CLEANUP

When the excavation has reached the approximate limits shown or when the COR determines that a satisfactory foundation may have been reached, the COR may direct that a preliminary cleanup be performed on all or any part of the rock foundation surface. This cleanup shall consist of removing all debris, loose rock, sand, silt, and other objectionable material by hand tools followed by water jets or any combination of additional methods approved or directed. The COR may require that the excavation be continued and the preliminary cleanup procedure repeated until a satisfactory foundation surface is reached.

3.4 FINAL CLEANUP AND FOUNDATION PREPARATION

Unless otherwise directed, Final Cleanup and Foundation Preparation shall be performed . This work shall consist of removing loose and/or weather rock and pockets of fines, sand, rock rubble or gravel and other objectionable material from the in place rock surface including areas of depression, large crevices, and open rock joints. Picking, barring, and hand excavation may be necessary to obtain a foundation surface free from loose, drummy, or shattered materials. Irregularities in the rock surfaces shall be trimmed to form a reasonable uniform slope on the abutments. Overhangs shall not be permitted at any location. Overhangs shall be excavated and backfilled with compacted granular materials. Placement of such filter materials shall be in accordance with the provisions contained in Section . Vertical surfaces shall not be permitted. and benches between vertical surfaces shall be of such width so as to provide a stepped slope comparable to the adjacent uniform slope. The final rock surface shall be thoroughly cleaned by use of water jets or other approved method and shall be maintained in a clean condition until the placement of concrete thereon.

3.5 PROTECTIVE TREATMENT

Protective treatment shall be.

3.5.1 Wetting

Keep the area wet by continuous spraying or by other approved method. Provide positive measures to control the runoff.

3.5.2 Protective Coating

Apply an approved protective coating within 72 hours of exposure of the rock surface in accordance with the manufacturer's recommendations or as otherwise approved. Reapply the coating as necessary to repair damage caused by construction activities or when needed to provide adequate protection.

3.5.3 Protective Backfill

The final 2 feet of excavation, final cleanup and foundation preparation, inspection, and placement of the first 12 inches of backfill shall all be accomplished within a period of 16 hours. Within 48 hours after the start of the final excavation, the backfill shall have a minimum thickness of 3 feet. The backfill shall be placed in accordance with the requirements of Section 31 00 00 EARTHWORK .

3.5.4 Protective Concrete

The final 2 feet of excavation, cleanup, inspection, preparation, dental treatment, and placement of at least 57.5 inches of protective concrete, shall all be accomplished within a period of 48 hours. The concrete shall conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE .

3.6 TESTS

3.6.1 General

Establish and maintain quality control for foundation preparation operations to assure compliance with contract specifications and maintain records of the quality control for all operations including but not limited to the following:

3.6.1.1 Equipment

Quantity and type.

3.6.1.2 Foundation Excavation

Strict adherence to foundation excavation limits and depths.

3.6.1.3 Inspection, Mapping, and Cleanup

Orderly prosecution of inspections, mapping, and cleanup of foundation excavation areas.

3.6.1.4 Specialized operations

Protective treatment.

3.6.2 Reports

Submit three copies of these records of inspection as well as corrective action taken daily.

3.7 FOUNDATION INSPECTION AND GEOLOGIC MAPPING

Inspections to determine adequacy of the foundations will be performed by the COR in all foundation areas between completion of excavation and placement of concrete, . The Contractor will cooperate to the extent necessary to assist in inspection and mapping activities which may require additional survey control points and access. Coordinate the schedule for foundation excavation and preliminary cleanup with the COR to ensure that the cleanup, inspection, and mapping proceed in an orderly manner.

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SECTION 32 12 17

HOT MIX BITUMINOUS PAVEMENT

PART 1 GENERAL

1.1 SUMMARY

This section covers hot-mix asphalt pavement for leveling, binder, and wearing courses using virgin materials.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASPHALT INSTITUTE (AI)

AI MS-02	Mix Design Methods

ASTM INTERNATIONAL (ASTM)

ASTM C 117	Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 128	Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C 131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 188	Standard Test Method for Density of Hydraulic Cement
ASTM C 29/C 29M	Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 88	Standard Test Method for Soundness of

	Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D 1073	Fine Aggregate for Bituminous Paving Mixtures
ASTM D 1188	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
ASTM D 140/D 140M	Standard Practice for Sampling Bituminous Materials
ASTM D 1559	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 242/D 242M	Mineral Filler for Bituminous Paving Mixtures
ASTM D 2726	Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D 4867/D 4867M	Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 546	Sieve Analysis of Mineral Filler for Bituminous Paving Mixtures
ASTM D 692/D 692M	Coarse Aggregate for Bituminous Paving Mixtures
ASTM D 70	Specific Gravity and Density of Semi-Solid Bituminous Materials (Pycnometer Method)
ASTM D 75/D 75M	Standard Practice for Sampling Aggregates
ASTM D 854	Specific Gravity of Soil Solids by Water Pycnometer
ASTM D 979	Sampling Bituminous Paving Mixtures
ASTM D 995	Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D2041/D2041M	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2172/D2172M	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D946/D946M	Penetration-Graded Asphalt Cement for Use in Pavement Construction

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Bituminous pavement

SD-05 Design Data

Job-mix formula

Submit a job-mix formula, prepared specifically for this project within one year of submittal for roads, for approval by the COR prior to preparing and placing the bituminous mixture. Design mix using procedures contained in Chapter V, Marshall Method of Mix Design, of AI MS-02. Formulas shall indicate physical properties of the mixes as shown by tests made by a commercial laboratory approved by the COR, using materials identical to those to be provided on this project. Submit formulas with material samples. Job-mix formula for each mixture shall be in effect until modified in writing by the Contractor and approved by the COR. Provide a new job-mix formula for each source change. Submittal shall include all tests indicated in MIX DESIGN section of this specification.

ASPHALT CEMENT BINDER

MIX DESIGN

SD-06 Test Reports

Specific gravity test of asphalt

Coarse aggregate tests

Weight of slag test

Percent of crushed pieces in gravel

Fine aggregate tests

Specific gravity of mineral filler

Bituminous mixture tests

Aggregates tests

Bituminous mix tests

Pavement courses

Submit in accordance with paragraph entitled "Mock-Up Test Section."

1.4 QUALITY ASSURANCE

1.4.1 Safety Requirements

Provide adequate and safe stairways with handrails to the mixer platform, and safe and protected ladders or other means for accessibility to plant operations. Guard equipment and exposed steam or other high temperature lines or cover with a suitable type of insulation.

1.4.2 Required Data

Job-mix formula shall show the following:

a. Source and proportions, percent by weight, of each ingredient of the mixture;

b. Correct gradation, the percentages passing each size sieve listed in the specifications for the mixture to be used, for the aggregate and mineral filler from each separate source and from each different size to be used in the mixture and for the composite mixture;

c. Amount of material passing the No. 200 sieve determined by dry sieving;

d. Number of blows of hammer compaction per side of molded specimen;

e. Temperature viscosity relationship of the asphalt cement;

f. Stability, flow, percent voids in mineral aggregate, percent air voids, unit weight;

g. Asphalt absorption by the aggregate;

h. Effective asphalt content as percent by weight of total mix;

i. Temperature of the mixture immediately upon completion of mixing;

j. Asphalt performance grade penetration range; and

k. Curves for the leveling binder and wearing courses.

1.4.3 Charts

Plot and submit, on a grain size chart, the specified aggregate gradation band, the job-mix gradation and the job-mix tolerance band.

1.4.4 Selection of Optimum Asphalt Content

Base selection on percent of total mix and the average of values at the following points on the curves for each mix:

a. Stability: Peak

b. Unit Weight: Peak

c. Percent Air Voids: Median

1.5 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage and store with a minimum of handling. Store aggregates in such a manner as to prevent segregation, contamination, or intermixing of the different aggregate sizes.

1.6 ENVIRONMENTAL CONDITIONS

Place bituminous mixture only during dry weather and on dry surfaces. Place courses only when the surface temperature of the underlying course is greater than 45 degrees F for course thicknesses greater than one inch and

55 degrees F for course thicknesses one inch or less.

1.7 CONSTRUCTION EQUIPMENT

Calibrated equipment, such as scales, batching equipment, spreaders and similar equipment, shall have been recalibrated by a calibration laboratory approved by the COR within 12 months of commencing work.

1.7.1 Mixing Plant

Design, coordinate, and operate the mixing plant to produce a mixture within the job-mix formula tolerances and to meet the requirements of ASTM D 995, including additional plant requirements specified herein. The plant shall be a batch type, continuous mix type or drum-dryer mixer type, and shall have sufficient capacity to handle the new bituminous construction. Minimum plant capacity shall be 100 tons per hour. The mixing plant and equipment shall remain accessible at all times for inspecting operation, verifying weights, proportions and character of materials, and checking mixture temperatures. The plant and plant site shall meet the requirements of Section 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS.

1.7.1.1 Cold Aggregate Feeder

Provide plant with a feeder or feeders capable of delivering the maximum number of aggregate sizes required in their proper proportion. Provide adjustment for total and proportional feed and feeders capable of being locked in any position. When more than one cold elevator is used, feed each elevator as a separate unit and install individual controls integrated with a master control.

1.7.1.2 Dryer

Provide rotary drum-dryer which continuously agitates the mineral aggregate during the heating and drying process. When one dryer does not dry the aggregate to specified moisture requirements, provide additional dryers.

1.7.1.3 Plant Screens and Bins for Batch and Continuous Mix Plants

Use screen to obtain accurate gradation and allow no bin to contain more than 10 percent oversize or undersize. Inspect screens each day prior to commencing work for plugged, worn, or broken screens. Clean plugged screens and replace worn or broken screens with new screens prior to beginning operations. Divide hot aggregate bins into at least three compartments arranged to ensure separate and adequate storage of appropriate fractions of the aggregate.

1.7.1.4 Testing Laboratory

Provide a testing laboratory for control and acceptance testing functions during periods of mix production, sampling and testing, and whenever materials subject to the provisions of these specifications are being supplied or tested. The laboratory shall provide adequate equipment, space, and utilities as required for the performance of the specified tests.

1.7.1.5 Surge and Storage Bins

Use for temporary storage of hot bituminous mixtures will be permitted under the following conditions:

a. When stored in surge bins for a period of time not to exceed 3 hours.

b. When stored in insulated and heated storage bins for a period of time not to exceed 12 hours. If it is determined by the COR that there is an excessive amount of heat loss, segregation and oxidation of the mixture due to temporary storage, discontinue use of surge bins or storage bins.

1.7.1.6 Drum-Dryer Mixer

Do not use drum-dryer mixer if specified requirements of the bituminous mixture or of the completed bituminous pavement course cannot be met. If drum-dryer mixer is prohibited, use either batch or continuous mix plants meeting the specifications and producing a satisfactory mix.

1.7.2 Paving Equipment

1.7.2.1 Spreading Equipment

Self-propelled electronically controlled type, unless other equipment is authorized by the COR. Equip spreading equipment of the self-propelled electronically controlled type with hoppers, tamping or vibrating devices, distributing screws, electronically adjustable screeds, and equalizing devices. Capable of spreading hot bituminous mixtures without tearing, shoving, or gouging and to produce a finished surface of specified grade and smoothness. Operate spreaders, when laying mixture, at variable speeds between 5 and 45 feet per minute. Design spreader with a quick and efficient steering device; a forward and reverse traveling speed; and automatic devices to adjust to grade and confine the edges of the mixture to true lines. The use of a spreader that leaves indented areas or other objectionable irregularities in the fresh laid mix during operations is prohibited.

1.7.2.2 Rolling Equipment

Self-propelled pneumatic-tired rollers supplemented by three-wheel and tandem type steel wheel rollers. The number, type and weight of rollers shall be sufficient to compact the mixture to the required density without detrimentally affecting the compacted material. Rollers shall be suitable for rolling hot-mix bituminous pavements and capable of reversing without backlash. Pneumatic-tired rollers shall be capable of being operated both forward and backward without turning on the mat, and without loosening the surface being rolled. Equip rollers with suitable devices and apparatus to keep the rolling surfaces wet and prevent adherence of bituminous mixture. Vibratory rollers especially designed for bituminous concrete compaction may be used provided rollers do not impair stability of pavement structure and underlying layers. Repair depressions in pavement surfaces resulting from use of vibratory rollers. Rollers shall be self-propelled, single or dual vibrating drums, and steel drive wheels, as applicable; equipped with variable amplitude and separate controls for energy and propulsion.

1.7.2.3 Hand Tampers

Minimum weight of 25 pounds with a tamping face of not more than 50 square inches.

1.7.2.4 Mechanical Hand Tampers

Commercial type, operated by pneumatic pressure or by internal combustion.

PART 2 PRODUCTS

2.1 AGGREGATES

Grade and proportion aggregates and filler so that combined mineral aggregate conforms to specified grading.

2.1.1 Coarse Aggregates

ASTM D 692/D 692M, except as modified herein. At least 75 percent by weight of aggregate retained on the No. 4 sieve shall have two or more fractured faces. Percentage of wear, Los Angeles test, except for slag, shall not exceed 40 in accordance with ASTM C 131. Weight of slag shall not be less than 70 pounds per cubic foot. Soundness test is required in accordance with ASTM C 88; after 5 cycles, loss shall not be more than 12 percent when tested with sodium sulfate or 18 percent when tested with magnesium sulfate.

2.1.2 Fine Aggregate

ASTM D 1073, except as modified herein. Fine aggregate shall be produced by crushing stone, slag or gravel that meets requirements for wear and soundness specified for coarse aggregate. Where necessary to obtain the gradation of aggregate blend or workability, natural sand may be used. Quantity of natural sand to be added shall be approved by the COR and shall not exceed 15 percent of weight of coarse and fine aggregate and material passing the No. 200sieve.

2.1.3 Mineral Filler

Nonplastic material meeting the requirements of ASTM D 242/D 242M.

2.1.4 Aggregate Gradation

The combined aggregate gradation shall conform to gradations specified in Table I, when tested in accordance with ASTM C 136 and ASTM C 117, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

Table I. Aggregate Gradations

Sieve Size, inch	Gradation 1 Percent Passing by Mass	Gradation 2 Percent Passing by Mass	Gradation 3 Percent Passing by Mass
1	100	---	---
3/4	76-96	100	---
1/2	68-88	76-96	100
3/8	60-82	69-89	76-96
No. 4	45-67	53-73	58-78
No. 8	32-54	38-60	40-60
No. 16	22-44	26-48	28-48
No. 30	15-35	18-38	18-38
No. 50	9-25	11-27	11-27

No. 100	6-18	6-18	6-18
No. 200	3-6	3-6	3-6

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to ASTM D946/D946M Penetration Grade 1A. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Engineer. The supplier is defined as the last source of any modification to the binder. The Engineer may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained by the Contractor in accordance with ASTM D 140/D 140M and in the presence of the Engineer. These samples shall be furnished to the Engineer for the verification testing, which shall be at no cost to the Contractor. Samples of the asphalt cement specified shall be submitted for approval not less than 14 days before start of the test section.

2.3 MIX DESIGN

The Contractor shall develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). No hot-mix asphalt for payment shall be produced until a JMF has been approved. The hot-mix asphalt shall be designed using procedures contained in AI MS-02 and the criteria shown in Table II. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867/D 4867M is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an approved anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it shall be provided by the Contractor at no additional cost.

2.3.1 JMF Requirements

The job mix formula shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of the test section and shall include as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt cement.

c. Percent of each aggregate and mineral filler to be used.

d. Asphalt viscosity grade, penetration grade, or performance grade.

e. Number of blows of hammer per side of molded specimen.

f. Laboratory mixing temperature.

g. Lab compaction temperature.

h. Temperature-viscosity relationship of the asphalt cement.

i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.

j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-02.

k. Specific gravity and absorption of each aggregate.

l. Percent natural sand.

m. Percent particles with two or more fractured faces (in coarse aggregate).

n. Fine aggregate angularity.

o. Percent flat or elongated particles (in coarse aggregate).

p. Tensile Strength Ratio.

q. Antistrip agent (if required) and amount.

r. List of all modifiers and amount.

s. Percentage and properties (asphalt content, binder properties, and aggregate properties) of RAP in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table II. Marshall Design Criteria

Test Property	75 Blow Mix	50 Blow Mix
Stability, pounds minimum	*2150	*1350
Flow, 0.01 inch	8-16	8-18
Air voids, percent	3-5	3-5
Percent Voids in mineral aggregate (minimum)	See Table III	See Table III
TSR, minimum percent	75	75

* This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.

Table III. Minimum Percent Voids in Mineral Aggregate (VMA)**

Aggregate (See Table 2)	Minimum VMA, percent
Gradation 1	13.0
Gradation 2	14.0
Gradation 3	15.0

** Calculate VMA in accordance with AI MS-02, based on ASTM D 2726 bulk specific gravity for the aggregate.

2.3.2 Adjustments to JMF

The JMF for each mixture shall be in effect until a new formula is approved in writing by the . Should a change in sources of any materials be made, a new mix design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the JMF within the limits specified below to optimize mix volumetric properties. Adjustments to the JMF shall be limited to plus or minus 3 percent on the 1/2 inch, No. 4, and No. 8 sieves; plus or minus 1.0 percent on the No. 200 sieve; and plus or minus 0.40 percent binder content. If adjustments are needed that exceed these limits, a new mix design shall be developed. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table I; this is acceptable.

2.4 RECYCLED HOT MIX ASPHALT

Recycled HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. The RAP shall be of a consistent gradation and asphalt content and properties. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed 2 inches. The recycled HMA mix shall be designed using procedures contained in AI MS-02. The job mix shall meet the requirements of paragraph MIX DESIGN. RAP should only be used for shoulder surface course mixes and for any intermediate courses. The amount of RAP shall be limited to 30 percent.

2.4.1 RAP Aggregates and Asphalt Cement

The blend of aggregates used in the recycled mix shall meet the requirements of paragraph AGGREGATES. The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D2172/D2172M using the appropriate dust correction procedure.

2.4.2 RAP Mix

The blend of new asphalt cement and the RAP asphalt binder shall meet the penetration requirements in paragraph ASPHALT CEMENT BINDER. The virgin asphalt cement shall not be more than two standard asphalt material grades different than that specified in paragraph ASPHALT CEMENT BINDER.

2.5 SOURCE QUALITY CONTROL

Employ a commercial laboratory approved by the COR to perform testing. The laboratory used to develop the JMF and the laboratory used to perform all sampling and testing shall meet the requirements of ASTM D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the COR prior to the start of construction. The certification shall contain as a minimum:

a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix.

c. A copy of the laboratory's quality control system.

d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

2.5.1 Tests

Perform testing in accordance with the following:

a. Specific Gravity Test of Asphalt: ASTM D 70

b. Coarse Aggregate Tests:

1. Bulk Specific Gravity: ASTM C 127

2. Abrasion Loss: ASTM C 131

3. Soundness Loss: ASTM C 88

c. Weight of Slag Test: ASTM C 29/C 29M

d. Percent of Crushed Pieces in Gravel: Count by observation and weight

e. Fine Aggregate Tests:

1. Bulk Specific Gravity: ASTM C 128

2. Soundness Loss: ASTM C 88

f. Specific Gravity of Mineral Filler: ASTM C 188 or ASTM D 854

g. Bituminous Mixture Tests:

1. Bulk Specific Gravity: ASTM D 1188 or ASTM D 2726

2. Theoretical Maximum Specific Gravity: ASTM D2041/D2041M

3. Tensile Strength Ratio: ASTM D 4867/D 4867M

2.5.2 Specimens

ASTM D 1559 for the making and testing of bituminous specimens with the following exceptions:

a. Compaction: Apply 75 blows of the hammer to each flat face of the specimens gathered from the asphalt plant providing the project with the asphalt concrete mix a minimum of two (2) times for every 8 hour day.

b. Curves: Plot curves for the leveling, binder, and wearing courses to show the effect on the test properties of at least four different percentages of asphalt on the unit weight, stability, flow, air voids, and voids in mineral aggregate; each point on the curves shall represent the average of at least four specimens.

c. Cooling of Specimen: After compaction is completed, allow the specimen to cool in air to the same temperature approximately as that of the water, 77 degrees F, to be used in the specific gravity determination.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Preparation of Asphalt Binder Material

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 160 degrees C 325 degrees F when added to the aggregates. Modified asphalts shall be no more than 174 degrees C 350 degrees F when added to the aggregate.

3.1.2 Preparation of Mineral Aggregates

Store different size aggregate in separate stockpiles so that different sizes will not mix. Stockpile different-sized aggregates in uniform layers by use of a clam shell or other approved method so as to prevent segregation. The use of bulldozers in stockpiling of aggregate or in feeding aggregate to the dryer is prohibited. Feed aggregates into the cold elevator by means of separate mechanical feeders so that aggregates are graded within requirements of the job-mix formulas and tolerances specified. Regulate rates of feed of the aggregates so that moisture content and temperature of aggregates are within tolerances specified herein. Dry and heat aggregates to the temperature necessary to achieve the mixture determined by the job mix formula within the job tolerance specified. Provide adequate dry storage for mineral filler.

3.1.3 Preparation of Bituminous Mixture

Accurately weigh aggregates and dry mineral filler and convey into the mixer in the proportionate amounts of each aggregate size required to meet the job-mix formula. In batch mixing, after aggregates and mineral filler have been introduced into the mixer and mixed for not less than 15 seconds, add asphalt by spraying or other approved methods and continue mixing for a period of not less than 20 seconds, or as long as required to obtain a homogeneous mixture. The time required to add or spray asphalt into the mixer will not be added to the total wet-mixing time provided the operation does not exceed 10 seconds and a homogeneous mixture is obtained. When a continuous mixer is employed, mixing time shall be more than 35 seconds to obtain a homogeneous mixture. Additional mixing time, when required, will be as directed by the COR. When mixture is prepared in a twin-pugmill mixer, volume of the aggregates, mineral filler, and asphalt shall not extend above tips of mixer blades when blades are in a vertical position. Overheated and carbonized mixtures, or mixtures that foam or show indication of free moisture, will be rejected. When free moisture is detected in batch or continuous mix plant produced mixtures, waste the mix and withdraw the aggregates in the hot bins immediately and return to the respective stockpiles; for drum-dryer mixer plants, waste the mix, including that in surge or storage bins that is affected by free moisture.

3.1.4 Transportation of Bituminous Mixtures

Transport bituminous material from the mixing plant to the paving site in trucks having tight, clean, smooth beds that have been coated with a minimum amount of concentrated solution of hydrated lime and water or other approved coating to prevent adhesion of the mixture to the truck. Petroleum products will not be permitted for coating truck. If air temperature is less than 60 degrees F or if haul time is greater than 30 minutes, cover

each load with canvas or other approved material of ample size to protect the mixture from the loss of heat. Make deliveries so that the spreading and rolling of all the mixture prepared for one day's run can be completed during daylight, unless adequate approved artificial lighting is provided. Deliver mixture to area to be paved so that the temperature at the time of dumping into the spreader is within the range specified herein. Reject loads that are below minimum temperature, that have crusts of cold unworkable material, or that have been wet excessively by rain. Hauling over freshly laid material is prohibited.

3.1.5 Surface Preparation of Underlying Course

Prior to the laying of the asphalt concrete, clean underlying course of foreign or objectionable matter with power blowers or power brooms, supplemented by hand brooms and other cleaning methods where necessary. During the placement of multiple lifts of bituminous concrete, each succeeding lift of bituminous concrete shall have its underlying lift cleaned and provided with a bituminous tack coat if the time period between the placement of each lift of bituminous concrete exceeds 14 days, or the underlying bituminous concrete has become dirty.

3.1.6 Spraying of Contact Surfaces

Spray contact surfaces of previously constructed pavement with a thin coat of bituminous materials to act as an anti-stripping agent, conforming to Section 32 12 21 BITUMINOUS ROAD-MIX SURFACE COURSE. Paint contact surfaces of structures with a thin coat of emulsion or other approved bituminous material prior to placing the bituminous mixture. Tack coat the previously placed primed coats on base courses when surface has become excessively dirty and cannot be cleaned or when primed surface has cured to the extent that it has lost all bonding effect.

3.2 PLACEMENT

3.2.1 Machine Spreading

The range of temperatures of the mixtures at the time of spreading shall be between 250 degrees F and 300 degrees F. Bituminous concrete having temperatures less than minimum spreading temperature when dumped into the spreader will be rejected. Adjust spreader and regulate speed so that the surface of the course is smooth and continuous without tears and pulling, and of such depth that, when compacted, the surface conforms with the cross section, grade, and contour indicated. Unless otherwise directed, begin the placing along the centerline of areas to be paved on a crowned section or on the high side of areas with a one-way slope. Place mixture in consecutive adjacent strips having a minimum width of 10 feet, except where the edge lanes require strips less than 10 feet to complete the area. Construct longitudinal joints and edges to true line markings. Establish lines parallel to the centerline of the area to be paved, and place string lines coinciding with the established lines for the spreading machine to follow. Provide the number and location of the lines needed to accomplish proper grade control. When specified grade and smoothness requirements can be met for initial lane construction by use of an approved long ski-type device of not less than 30 feet in length and for subsequent lane construction by use of a short ski or shoe, in-place string lines for grade control may be omitted. Place mixture as nearly continuous as possible and adjust the speed of placing as needed to permit proper rolling.

3.2.2 Shoveling, Raking, and Tamping After Machine-Spreading

Shovelers and rakers shall follow the spreading machine. Add or remove hot mixture and rake the mixture as required to obtain a course that when completed will conform to requirements specified herein. Broadcasting or fanning of mixture over areas being compacted is prohibited. When segregation occurs in the mixture during placing, suspend spreading operation until the cause is determined and corrected. Correct irregularities in alignment left by the spreader by trimming directly behind the machine. Immediately after trimming, compact edges of the course by tamping laterally with a metal lute or by other approved methods. Distortion of the course during tamping is prohibited.

3.2.3 Hand-Spreading in Lieu of Machine-Spreading

In areas where the use of machine spreading is impractical, spread mixture by hand. The range of temperatures of the mixtures when dumped onto the area to be paved shall be between 250 and 300 degrees F. Mixtures having temperatures less than minimum spreading temperature when dumped onto the area to be paved will be rejected. Spread hot mixture with rakes in a uniformly loose layer of a thickness that, when compacted, will conform to the required grade, thickness, and smoothness. During hand spreading, place each shovelful of mixture by turning the shovel over in a manner that will prevent segregation. Do not place mixture by throwing or broadcasting from a shovel. Do not dump loads any faster than can be properly handled by the shovelers and rakers.

3.3 COMPACTION OF MIXTURE

Compact mixture by rolling. Begin rolling as soon as placement of mixture will bear rollers. Delays in rolling freshly spread mixture shall not be permitted. Start rolling longitudinally at the extreme sides of the lanes and proceed toward center of pavement, or toward high side of pavement with a one-way slope. Operate rollers so that each trip overlaps the previous adjacent strip by at least one foot. Alternate trips of the roller shall be of slightly different lengths. Conduct tests for conformity with the specified crown, grade and smoothness immediately after initial rolling. Before continuing rolling, correct variations by removing or adding materials as necessary. If required, subject course to diagonal rolling with the steel wheeled roller crossing the lines of the previous rolling while mixture is hot and in a compactible condition. Speed of the rollers shall be slow enough to avoid displacement of hot mixture. Correct displacement of mixture immediately by use of rakes and fresh mixture, or remove and replace mixture as directed. Continue rolling until roller marks are eliminated and course has a density of at least 95 percent but not more than 100 percent of that attained in a laboratory specimen of the same mixture prepared in accordance with ASTM D 1559. During rolling, moisten wheels of the rollers enough to prevent adhesion of mixture to wheels, but excessive water is prohibited. Operation of rollers shall be by competent and experienced operators. Provide sufficient rollers for each spreading machine in operation on the job and to handle plant output. In places not accessible to the rollers, compact mixture thoroughly with hot hand tampers. Skin patching of an area after compaction is prohibited. Remove mixture that becomes mixed with foreign materials or is defective and replace with fresh mixture compacted to the density specified herein. Roller shall pass over unprotected edge of the course only when laying of course is to be discontinued for such length of time as to permit mixture to become cold.

3.4 JOINTS

Joints shall present the same texture and smoothness as other portions of the course, except permissible density at the joint may be up to 2 percent less than the specified course density. Carefully make joints between old and new pavement or within new pavements in a manner to ensure a thorough and continuous bond between old and new sections of the course. Vertical contact surfaces of previously constructed sections that are coated with dust, sand, or other objectionable material shall be painted with a thin uniform coat of emulsion or other approved bituminous material just before placing fresh mixture.

3.4.1 Transverse

Roller shall pass over unprotected end of freshly laid mixture only when laying of course is to be discontinued. Except when an approved bulkhead is used, cut back the edge of previously laid course to expose an even, vertical surface for the full thickness of the course. When required, rake fresh mixture against joints, thoroughly tamp with hot tampers, smooth with hot smoothers, and roll. Transverse joints in adjacent lanes shall be offset a minimum of 2 feet.

3.4.2 Longitudinal Joints

Space 6 inches apart. Do not allow joints to coincide with joints of existing pavement or previously placed courses. Spreader screed shall overlap previously placed lanes 2 to 3 inches and be of such height to permit compaction to produce a smooth dense joint. With a lute, push back mixture placed on the surface of previous lanes to the joint edge. Do not scatter mix. Remove and waste excess material. When edges of longitudinal joints are irregular, honeycombed, or poorly compacted, cut back unsatisfactory sections of joint and expose an even vertical surface for the full thickness of the course. When required, rake fresh mixture against joint, thoroughly tamp with hot tampers, smooth with hot smoothers, and roll while hot.

3.5 FIELD QUALITY CONTROL

3.5.1 Sampling

3.5.1.1 Aggregates At Source

Prior to production and delivery of aggregates, take at least one initial sample in accordance with ASTM D 75/D 75M from each stockpile. Collect each sample by taking three incremental samples at random from the source material to make a composite sample of not less than 50 pounds. Repeat the sampling when the material source changes or when testing reveals unacceptable deficiencies or variations from the specified grading of materials.

3.5.1.2 Cold Feed Aggregate Sampling

Take two samples daily from the belt conveying materials from the cold feed. Collect materials in three increments at random to make a representative composite sample of not less than 50 pounds. Take samples in accordance with ASTM D 75/D 75M.

3.5.1.3 Coarse and Fine Aggregates

Take a 50 pound sample from the cold feed at least once daily for sieve analyses and specific gravity tests. Additional samples may be required to perform more frequent tests when analyses show deficiencies, or unacceptable variances or deviations. The method of sampling is as specified herein for aggregates.

3.5.1.4 Mineral Filler

ASTM D 546. Take samples large enough to provide ample material for testing.

3.5.1.5 Pavement and Mixture

Take plant samples for the determination of mix properties and field samples for thickness and density of the completed pavements. Furnish tools, labor and material for samples, and satisfactory replacement of pavement. Take samples and tests at not less than frequency specified hereinafter and at the beginning of plant operations; for each day's work as a minimum; each change in the mix or equipment; and as often as directed. Accomplish sampling in accordance with ASTM D 979.

3.5.2 Testing

3.5.2.1 Aggregates Tests

a. Gradation: ASTM C 136.

b. Mineral Filler Content: ASTM D 546.

c. Abrasion: ASTM C 131 for wear (Los Angeles test). Perform one test initially prior to incorporation into the work and each time the source is changed.

3.5.2.2 Bituminous Mix Tests

Test one sample for each 500 tons, or fraction thereof, of the uncompacted mix for extraction in accordance with ASTM D2172/D2172M; perform a sieve analysis on each extraction sample in accordance with ASTM C 136 and ASTM C 117. Test one sample for each 500 tons or fraction thereof for stability and flow in accordance with ASTM D 1559. Test one sample for each material blend for Tensile Strength Ratio in accordance with ASTM D 4867/D 4867M.

3.5.2.3 Pavement Courses

Perform the following tests:

a. Density: For each 1000 tons of bituminous mixture placed, determine the representative laboratory density by averaging the density of four laboratory specimens prepared in accordance with ASTM D 1559. Samples for laboratory specimens shall be taken from trucks delivering mixture to the site; record in a manner approved by the COR the project areas represented by the laboratory densities. From each representative area recorded, determine field density of pavement by averaging densities of 4 inch diameter cores obtained from leveling, binder, and wearing course s; take one core for each 2000 square yards or fraction thereof of course placed. Determine density of laboratory prepared specimens and

cored samples in accordance with ASTM D 1188 or ASTM D 2726, as applicable. Separate pavement layers by sawing or other approved means. Maximum allowable deficiency at any point, excluding joints, shall not be more than 2 percent less than the specified density for any course. The average density of each course, excluding joints, shall be not less than the specified density. Joint densities shall not be more than 2 percent less than specified course densities and are not included when calculating average course densities. When the deficiency exceeds the specified tolerances, correct each such representative area or areas by removing the deficient pavement and replacing with new pavement.

b. Thickness: Determine thickness of binder and wearing courses from samples taken for the field density test. The maximum allowable deficiency at any point shall not be more than 1/4 inch less than the thickness for the indicated course. Average thickness of course or of combined courses shall be not less than the indicated thickness. Where a deficiency exceeds the specified tolerances, correct each such representative area or areas by removing the deficient pavement and replacing with new pavement.

c. Smoothness: Straightedge test the compacted surface of leveling, binder, and wearing courses as work progresses. Apply straightedge parallel with and at right angles to the centerline after final rolling. Unevenness of leveling and binder courses shall not vary more than 1/4 inch in 10 feet; variations in the wearing course shall not vary more than 1/8 inch in 10 feet. Correct each portion of the pavement showing irregularities greater than that specified.

d. Finished Grades: Finish grades of each course placed shall not vary from the finish elevations, profiles, and cross sections indicated by more than 1/2 inch. Finished surface of the final wearing course will be tested by the COR by running lines of levels at intervals of 25 feet longitudinally and transversely to determine elevations of completed pavement. Within 45 days after completion of final placement, Correct deficient paved areas by removing existing work and replacing with new materials that meet the specifications. Skin patching for correcting low areas is prohibited.

e. Finish Surface Texture of Wearing Course: Visually check final surface texture for uniformity and reasonable compactness and tightness.Final wearing course with a surface texture having undesirable irregularities such as segregation, cavities, pulls or tears, checking, excessive exposure of coarse aggregates, sand streaks, indentations, ripples, or lack of uniformity shall be removed and replaced with new materials.

3.6 PROTECTION

Do not permit vehicular traffic, including heavy equipment, on pavement until surface temperature has cooled to at least 120 degrees F. Measure surface temperature by approved surface thermometers or other satisfactory methods.

-- End of Section --

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SECTION 32 13 13.06

PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES

PART 1 GENERAL

1.1 SUMMARY

This section covers small portland cement concrete paving jobs such as roads, streets, sidewalks, and parking lots.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 301	Specifications for Structural Concrete
ACI 305R	Specification for Hot Weather Concreting
ACI 306.1	Standard Specification for Cold Weather Concreting

ASTM INTERNATIONAL (ASTM)

ASTM A184/A184M	Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A615/A615M	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A966/A966M	Standard Test Method for Magnetic Particle Examination of Steel Forgings Using Alternating Current
ASTM C 1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1260	Standard Test Method for Potential Alkali

	Reactivity of Aggregates (Mortar-Bar Method)
ASTM C 143/C 143M	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150/C 150M	Standard Specification for Portland Cement
ASTM C 171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33/C 33M	Standard Specification for Concrete Aggregates
ASTM C 494/C 494M	Standard Specification for Chemical Admixtures for Concrete
ASTM C 618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 94/C 94M	Standard Specification for Ready-Mixed Concrete
ASTM C 989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C172/C172M	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231/C231M	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C78/C78M	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM D 6270	Use of Scrap Tires in Civil Engineering Applications

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Curing materials

Admixtures

Dowel

Reinforcement

Submit a complete list of materials including type, brand and applicable reference specifications.

Cementitious Materials

Aggregate

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Local/Regional Materials

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Albedo

Provide information identifying the reflectance of the pavement.

SD-04 Samples

SD-05 Design Data

Concrete mix design

Thirty days minimum prior to concrete placement, submit a mix design, with applicable tests, for each strength and type of concrete for approval. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, slag, and admixtures; and applicable reference specifications. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required. Submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. Obtain acknowledgement of approvals prior to concrete placement. Submit a new mix design for each material source change.

SD-06 Test Reports

Aggregate tests

Concrete slump tests

Air content tests

Flexural strength tests

Cementitious materials

SD-07 Certificates

Ready-mixed concrete plant

Batch tickets

Cementitious materials

SD-11 Closeout Submittals

Local/Regional Materials

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Cementitious Materials

Aggregate

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Albedo

LEED documentation relative to heat island effect - non-roof credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.4 DELIVERY, STORAGE, AND HANDLING

ASTM C 94/C 94M.

1.5 QUALITY ASSURANCE

1.5.1 Ready-mixed Concrete Plant Certification

Provide documentation that the ready-mix plant is certified by the National Ready-Mix Concrete Association (NRMCA).

1.5.2 Required Information

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions. The laboratory test reports shall include mill test and all other test for cementitious materials, aggregates, and admixtures. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Test reports shall be submitted along with the concrete mix design. Sampling and testing of materials, concrete mix design, sampling and testing in the field shall be performed by a commercial testing laboratory which conforms to ASTM C 1077. The laboratory shall be approved in writing by the Government.

1.5.3 Batch Tickets

ASTM C 94/C 94M. Submit mandatory batch ticket information for each load of ready-mixed concrete.

1.5.4 Field-Constructed Mockup

Install minimum 225 square feet to demonstrate typical joints, surface finish, texture, color, permeability, and standard of workmanship. When COR determines that mockup does not meet requirements, demolish and remove it from the site and install another until the mockup is accepted. Keep accepted mockup undisturbed during construction as a standard for judging completed paving. Accepted mockup may be incorporated into final work when approved by COR.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mileradius from the project site, if available from a minimum of three sources.See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Pavement materials may be locally available.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Cementitious materials in concrete mix shall be 50 percent non-portland cement pozzolanic materials by weight. Provide test data demonstrating compatibility and performance of concrete satisfactory to COR.

2.1.1.1 Cement

ASTM C 150/C 150M, Type I or II with maximum alkali content of 0.60 percent. Cement certificate shall include test results in accordance with ASTM C 150/C 150M, including equivalent alkalies indicated in the Supplementary Optional Chemical Requirements.

2.1.1.2 Fly Ash and Pozzolan

ASTM C 618, Type F, except that the maximum allowable loss on ignition shall be 6 percent, maximum available alkalies content shall be 1.5 percent, and maximum calcium oxide (CaO) content 8 percent. Fly ash certificates shall include test results in accordance with ASTM C 618, including available alkalies indicated in the Supplementary Optional Chemical Requirements.

2.1.1.3 Slag

ASTM C 989, Ground Granulated Blast Furnace Slag (GGBFS), Grade 100 or 120. Certificates shall include test results in accordance with ASTM C 989.

2.1.2 Water

ASTM C 94/C 94M, fresh, clean, and potable.

2.1.3 Aggregate

Aggregate shall contain a minimum of 5 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content.

2.1.3.1 Alkali Reactivity Test

Aggregates to be used in all concrete shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with ASTM C 1260. The types of aggregates shall be evaluated in a combination which matches the contractors' proposed mix design (including Class F fly ash or GGBF slag), utilizing the modified version of ASTM C 1260. Test results of the combination shall have a measured expansion of less than 0.08 percent at 16 days. Should the test data indicate an expansion of greater than 0.08 percent, the aggregate(s) shall be rejected and the contractor shall submit new aggregate sources for retesting or may submit additional test results incorporating Lithium Nitrate for consideration.

ASTM C 1260 shall be modified as follows to include one of the following options:

a. Utilize the contractor's proposed low alkali Portland cement and Class F fly ash in combination for the test proportioning. The laboratory shall use the contractor's proposed percentage of cement and fly ash.

b. Utilize the contractor's proposed low alkali Portland cement and ground granulated blast furnace (GGBF) slag in combination for the test proportioning. The laboratory shall use the contractor's proposed percentage of cement and GGBF.

c. Utilize the contractor's proposed low alkali Portland cement and Class F fly ash and ground granulated blast furnace (GGBF) slag in combination for the test proportioning. The laboratory shall use the contractor's proposed percentage of cement, fly ash and GGBF.

2.1.3.2 Fine Aggregates

ASTM C 33/C 33M.

2.1.3.3 Coarse Aggregates

ASTM C 33/C 33M.

2.1.3.4 Tire Aggregate

Comply with ASTM D 6270, Class II Fill.

2.1.4 Admixtures

ASTM C 494/C 494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures. Where not shown or specified, the use of admixtures is subject to written approval of the COR.

ASTM C260/C260M: Air-entraining.

2.1.5 Reinforcement

2.1.5.1 Dowel Bars

Bars shall conform to ASTM A615/A615M,Grade 40 for plain billet-steel bars of the size and length indicated. Remove all burrs and projections from the bars.

2.1.5.2 Tie Bars

Bars shall be billet or axle steel deformed bars and conform to ASTM A615/A615M or ASTM A966/A966MGrade 40 .

2.1.5.3 Reinforcement

Deformed steel bar mats shall conform to ASTM A184/A184M. Bar reinforcement shall conform to ,Grade 40 .

2.1.6 Curing Materials

2.1.6.1 White-Burlap-Polyethylene Sheet

ASTM C 171, 0.004 inch thick white opaque polyethylene bonded to 10 oz/linear yard (40 inch) wide burlap.

2.1.6.2 Liquid Membrane-Forming Compound

ASTM C 309, white pigmented, Type 2, Class B, free of paraffin or petroleum.

2.1.7 Joint Fillers and Sealants

Provide as specified in Section 32 13 73 COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS. New joints shall match existing alignment.

2.2 CONCRETE PAVEMENT

2.2.1 Albedo

2.3 CONTRACTOR-FURNISHED MIX DESIGN

Contractor-furnished mix design concrete shall be designed in accordance with ACI 211.1 except as modified herein, and the mix design shall be as specified herein under paragraph entitled "Submittals." The concrete shall have a minimum flexural strength of 650 pounds per square inch at 90 days. The concrete may be air entrained. If air entrainment is used the air content shall be 5.0 plus or minus 1.5 percent. Maximum size aggregate for slip forming shall be 1.5 inches. The minimum cementitious factor is 564 lbs per cubic yard and slump shall be 1 to 3 inches (or less when slip form is used).

If the cementitious material is not sufficient to produce concrete of the flexural strength required it shall be increased as necessary, without additional compensation under the contract. The cementitious factor shall be calculated using cement, Class F fly ash, and or GGBF slag. The mix shall use a cement replacement (by weight) of 25 percent - 35 percent Class F fly ash, or 40 percent - 50 percent GGBF slag, or a combination of the two. In the combination, each 5 percent of Class F fly ash shall be replaced by 8 percent GGBF slag.

PART 3 EXECUTION

3.1 FORMS

3.1.1 Construction

Construct forms to be removable without damaging the concrete.

3.1.2 Coating

Before placing the concrete, coat the contact surfaces of forms except existing pavement sections where bonding is required, with a non-staining mineral oil, non-staining form coating compound, or two coats of nitro-cellulose lacquer. When using existing pavement as a form, clean existing concrete and then coat with asphalt emulsion bondbreaker before concrete is placed.

3.1.3 Grade and Alignment

Check and correct grade elevations and alignment of the forms immediately before placing the concrete.

3.2 REINFORCEMENT

3.2.1 Dowel Bars

Install bars accurately aligned, vertically and horizontally, at indicated locations and to the dimensions and tolerances indicated. Before installation thoroughly grease the sliding portion of each dowel. Dowels must remain in position during concrete placement and curing.

3.2.2 Coated Dowel Bars

Install bars, accurately aligned vertically and horizontally, at indicated locations and to the dimensions and tolerances indicated. Reject coatings which are perforated, cracked or otherwise damaged. While handling avoid scuffing or gouging of the coatings.

3.2.3 Tie Bars

Install bars, accurately aligned horizontally and vertically, at indicated locations.

3.2.4 Setting Slab Reinforcement

Reinforcement shall be positioned on suitable chairs prior to concrete placement. At expansion, contraction and construction joints, place the reinforcement as indicated. Reinforcement, when placed in concrete, shall be free of mud, oil, scale or other foreign materials. Place reinforcement accurately and wire securely. The laps at splices shall be 12 inches minimum and the distances from ends and sides of slabs and joints shall be as indicated.

3.3 MEASURING, MIXING, CONVEYING, AND PLACING CONCRETE

3.3.1 Measuring

ASTM C 94/C 94M.

3.3.2 Mixing

ASTM C 94/C 94M, except as modified herein. Begin mixing within 30 minutes after cement has been added to aggregates. When the air temperature is greater than 85 degrees F, reduce mixing time and place concrete within 60 minutes. Additional water may be added to bring slump within required limits as specified in Section 11.7 of ASTM C 94/C 94M, provided that the specified water-cement ratio is not exceeded.

3.3.3 Conveying

ASTM C 94/C 94M.

3.3.4 Placing

Follow guidance of ACI 301, except as modified herein. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete continuously at a uniform rate, with minimum amount of segregation, without damage to the grade and without unscheduled stops except for equipment failure or other emergencies. If this occurs within 10 feet of a previously placed expansion joint, remove concrete back to joint, repair any damage to grade, install a construction joint and continue placing concrete only after cause of the stop has been corrected.

3.3.5 Vibration

Immediately after spreading concrete, consolidate concrete with internal type vibrating equipment along the boundaries of all slabs regardless of slab thickness, and interior of all concrete slabs 6 inches or more in thickness. Limit duration of vibration to that necessary to produce consolidation of concrete. Excessive vibration will not be permitted. Vibrators shall not be operated in concrete at one location for more than 15 seconds. At the option of the Contractor, vibrating equipment of a type approved by the COR may be used to consolidate concrete in unreinforced pavement slabs less than 6 inches thick.

3.3.5.1 Vibrating Equipment

Operate equipment, except hand-manipulated equipment, ahead of the finishing machine. Select the number of vibrating units and power of each unit to properly consolidate the concrete. Mount units on a frame that is capable of vertical movement and, when necessary, radial movement, so vibrators may be operated at any desited depth within the slab or be completely withdrawn from the concrete. Clear distance between frame-mounted vibrating units that have spuds that extend into the slab at intervals across the paving lane shall not exceed 30 inches. Distance between end of vibrating tube and side form shall not exceed 2 inches. For pavements less than 10 inches thick, operate vibrators at mid-depth parallel with or at a slight angle to the subbase. For thicker pavements, angle vibrators toward the vertical, with vibrator tip preferably about 2 inches from subbase, and top of vibrator a few inches below pavement surface. Vibrators may be pneumatic, gas driven, or electric, and shall be operated at frequencies within the concrete of not less than 8,000 vibrations per minute. Amplitude of vibration shall be such that noticeable vibrations occur at 1.5 foot radius when the vibrator is inserted in the concrete to the depth specified.

3.3.6 Cold Weather

Except with authorization, do not place concrete when ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. When authorized, when concrete is likely to be subjected to freezing within 24 hours after placing, heat concrete materials so that temperature of concrete when deposited is between 65 and 80 degrees F. Methods of heating materials are subject to approval of the COR. Do not heat mixing water above 165 degrees F. Remove lumps of frozen material and ice from aggregates before placing aggregates in mixer. Follow practices found in ACI 306.1.

3.3.7 Hot Weather

Maintain required concrete temperature in accordance with Figure 2.1.5 in ACI 305R to prevent evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. After placement, use fog spray, apply monomolecular film, or use other suitable means to reduce the evaporation rate. Start curing when surface of fresh concrete is sufficiently hard to permit curing without damage. Cool underlying material by sprinkling lightly with water before placing concrete. Follow practices found in ACI 305R.

3.4 PAVING

Pavement shall be constructed with paving and finishing equipment utilizing fixed forms .

3.4.1 Consolidation

The paver vibrators shall be inserted into the concrete not closer to the underlying material than 2 inches. The vibrators or any tamping units in front of the paver shall be automatically controlled so that they shall be stopped immediately as forward motion ceases. Excessive vibration shall not be permitted. Concrete in small, odd-shaped slabs or in locations inaccessible to the paver mounted vibration equipment shall be vibrated with a hand-operated immersion vibrator. Vibrators shall not be used to transport or spread the concrete.

3.4.2 Operation

When the paver is operated between or adjacent to previously constructed pavement (fill-in lanes), provisions shall be made to prevent damage to the previously constructed pavement, including keeping the existing pavement surface free of any debris, and placing rubber mats beneath the paver tracks. Transversely oscillating screeds and extrusion plates shall overlap the existing pavement the minimum possible, but in no case more than 8 inches.

3.4.3 Required Results

The paver-finisher shall be operated to produce a thoroughly consolidated slab throughout, true to line and grade within specified tolerances. The paver-finishing operation shall produce a surface finish free of irregularities, tears, voids of any kind, and any other discontinuities. It shall produce only a very minimum of paste at the surface. Multiple passes of the paver-finisher shall not be permitted. The equipment and its

operation shall produce a finished surface requiring no hand finishing, other than the use of cutting straightedges, except in very infrequent instances. No water, other than true fog sprays (mist), shall be applied to the concrete surface during paving and finishing.

3.4.4 Fixed Form Paving

Forms shall be steel, except that wood forms may be used for curves having a radius of 150 feet or less, and for fillets. Forms may be built up with metal or wood, added only to the base, to provide an increase in depth of not more than 25 percent. The base width of the form shall be not less than eight-tenths of the vertical height of the form, except that forms 8 inches or less in vertical height shall have a base width not less than the vertical height of the form. Wood forms for curves and fillets shall be adequate in strength and rigidly braced. Forms shall be set on firm material cut true to grade so that each form section when placed will be firmly in contact with the underlying layer for its entire base. Forms shall not be set on blocks or on built-up spots of underlying material. Forms shall remain in place at least 12 hours after the concrete has been placed. Forms shall be removed without injuring the concrete.

3.4.5 Placing Reinforcing Steel

Reinforcement shall be positioned on suitable chairs securely fastened to the subgrade prior to concrete placement.

3.4.6 Placing Dowels and Tie Bars

Dowels shall be installed with alignment not greater than 1/8 inch per ft. Except as otherwise specified below, location of dowels shall be within a horizontal tolerance of plus or minus 5/8 inch and a vertical tolerance of plus or minus 3/16 inch. The portion of each dowel intended to move within the concrete or expansion cap shall be painted with one coat of rust inhibiting primer paint, and then oiled just prior to placement. Dowels in joints shall be omitted when the center of the dowel is located within a horizontal distance from an intersecting joint equal to or less than one-fourth of the slab thickness.

3.4.6.1 Contraction Joints

Dowels in longitudinal and transverse contraction joints within the paving lane shall be held securely in place by means of rigid metal basket assemblies. The dowels shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent them from becoming distorted during paving operations. The basket assemblies shall be held securely in the proper location by means of suitable anchors.

3.4.6.2 Construction Joints-Fixed Form Paving

Installation of dowels shall be by the bonded-in-place method, supported by means of devices fastened to the forms. Installation by removing and replacing in preformed holes will not be permitted.

3.4.6.3 Dowels Installed in Hardened Concrete

Installation shall be by bonding the dowels into holes drilled into the hardened concrete. Holes approximately 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete. Dowels shall be bonded in the drilled holes using epoxy resin injected at the back of the

hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel shall not be permitted. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic collar fitted around the dowel. The vertical alignment of the dowels shall be checked by placing the straightedge on the surface of the pavement over the top of the dowel and measuring the vertical distance between the straightedge and the beginning and ending point of the exposed part of the dowel.

3.4.6.4 Expansion Joints

Dowels in expansion joints shall be installed by the bonded-in-place method or by bonding into holes drilled in hardened concrete, using procedures specified above.

3.5 FINISHING CONCRETE

Start finishing operations immediately after placement of concrete. Use finishing machine, except hand finishing may be used in emergencies and for concrete slabs in inaccessible locations or of such shapes or sizes that machine finishing is impracticable. Finish pavement surface on both sides of a joint to the same grade. Finish formed joints from a securely supported transverse bridge. Provide hand finishing equipment for use at all times. Transverse and longitudinal surface tolerances shall be 1/4 inch in 10 feet.

3.5.1 Side Form Finishing

Strike off and screed concrete to the required slope and cross-section by a power-driven transverse finishing machine. Transverse rotating tube or pipe shall not be permitted unless approved by the COR. Elevation of concrete shall be such that, when consolidated and finished, pavement surface will be adequately consolidated and at the required grade. Equip finishing machine with two screeds which are readily and accurately adjustable for changes in pavement slope and compensation for wear and other causes. Make as many passes over each area of pavement and at such intervals as necessary to give proper compaction, retention of coarse aggregate near the finished surface, and a surface of uniform texture, true to grade and slope. Do not permit excessive operation over an area, which will result in an excess of mortar and water being brought to the surface.

3.5.1.1 Equipment Operation

Maintain the travel of machine on the forms without lifting, wobbling, or other variation of the machine which tend to affect the precision of concrete finish. Keep the tops of the forms clean by a device attached to the machine. During the first pass of the finishing machine, maintain a uniform ridge of concrete ahead of the front screed for its entire length.

3.5.1.2 Joint Finish

Before concrete is hardened, correct edge slump of pavement, exclusive of edge rounding, in excess of 0.02 foot. Finish concrete surface on each side of construction joints to the same plane, and correct deviations before newly placed concrete has hardened.

3.5.1.3 Hand Finishing

Strike-off and screed surface of concrete to elevations slightly above finish grade so that when concrete is consolidated and finished pavement surface is at the indicated elevation. Vibrate entire surface until required compaction and reduction of surface voids is secured with a strike-off template.

3.5.1.4 Longitudinal Floating

After initial finishing, further smooth and consolidate concrete by means of hand-operated longitudinal floats. Use floats that are not less than 12 feet long and 6 inches wide and stiffened to prevent flexing and warping.

3.5.2 Texturing

Before the surface sheen has disappeared and before the concrete hardens, the surface of the pavement shall be given a texture as described herein. Following initial texturing on the first day of placement, the Placing Foreman, COR representative, and a representative of the Using Agency shall inspect the texturing for compliance with design requirements. After curing is complete, all textured surfaces shall be thoroughly power broomed to remove all debris. The concrete in areas of recesses for tie-down anchors, lighting fixtures, and other outlets in the pavement shall be finished to provide a surface of the same texture as the surrounding area.

3.5.2.1 Brooming

Finish the surface of the slab by brooming the surface with a new wire broom at least 18 inches wide. Gently pull the broom over the surface of the pavement from edge to edge just before the concrete becomes non-plastic. Slightly overlap adjacent strokes of the broom. Broom perpendicular to centerline of pavement so that corrugations produced will be uniform in character and width, and not more than 1/16 inch in depth. Broomed surface shall be free from porous spots, irregularities, depressions, and small pockets or rough spots such as may be caused by accidentally disturbing particles of coarse aggregate embedded near the surface.

3.5.3 Edging

At the time the concrete has attained a degree of hardness suitable for edging, carefully finish slab edges, including edges at formed joints, with an edge having a maximum radius of one-eighth inch. When brooming is specified for the final surface finish, edge transverse joints before starting brooming, then operate broom to obliterate as much as possible the mark left by the edging tool without disturbing the rounded corner left by the edger. Clean by removing loose fragments and soupy mortar from corners or edges of slabs which have crumbled and areas which lack sufficient mortar for proper finishing. Refill voids solidly with a mixture of suitable proportions and consistency and refinish. Remove unnecessary tool marks and edges. Remaining edges shall be smooth and true to line.

3.5.4 Repair of Surface Defects

Follow guidance of ACI 301.

3.6 CURING AND PROTECTION

Protect concrete adequately from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks and oil stains, and do not allow it to dry out from the time it is placed until the expiration of the minimum curing periods specified herein. Use White-Burlap-Polyethylene Sheet or liquid membrane-forming compound, except as specified otherwise herein. Do not use membrane-forming compound on surfaces where its appearance would be objectionable, on surfaces to be painted, where coverings are to be bonded to concrete, or on concrete to which other concrete is to be bonded. Maintain temperature of air next to concrete above 40 degrees F for the full curing periods.

3.6.1 White-Burlap-Polyethylene Sheet

Wet entire exposed surface thoroughly with a fine spray of water, saturate burlap but do not have excessive water dripping off the burlap and then cover concrete with White-Burlap-Polyethylene Sheet, burlap side down. Lay sheets directly on concrete surface and overlap 12 inches. Make sheeting not less than 18 inches wider than concrete surface to be cured, and weight down on the edges and over the transverse laps to form closed joints. Repair or replace sheets when damaged during curing. Check daily to assure burlap has not lost all moisture. If moisture evaporates, resaturate burlap and re-place on pavement (re-saturation and re-placing shall take no longer than 10 minutes per sheet). Leave sheeting on concrete surface to be cured for at least 7 days.

3.6.2 Liquid Membrane-Forming Compound Curing

Apply compound immediately after surface loses its water sheen and has a dull appearance and before joints are sawed. Agitate curing compound thoroughly by mechanical means during use and apply uniformly in a two-coat continuous operation by suitable power-spraying equipment. Total coverage for the two coats shall be at least one gallon of undiluted compound per 200 square feet. Compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. Apply an additional coat of compound immediately to areas where film is defective. Respray concrete surfaces that are subject to heavy rainfall within 3 hours after curing compound has been applied in the same manner.

3.6.2.1 Protection of Treated Surfaces

Keep concrete surfaces to which liquid membrane-forming compounds have been applied free from vehicular traffic and other sources of abrasion for not less than 72 hours. Foot traffic is allowed after 24 hours for inspection purposes. Maintain continuity of coating for entire curing period and repair damage to coating immediately.

3.6.3 Liquid Chemical Sealer-Hardener

Apply sealer-hardener to interior floors not receiving floor covering and floors located under access flooring. Apply the sealer-hardener in accordance with manufacturer's recommendations. Seal or cover joints and openings in which joint sealant is to be applied as required by the joint sealant manufacturer. The sealer-hardener shall not be applied until the concrete has been moist cured and has aged for a minimum of 30 days. Apply a minimum of two coats of sealer-hardener.

3.7 FIELD QUALITY CONTROL

3.7.1 Sampling

The Contractor's approved laboratory shall collect samples of fresh concrete in accordance with ASTM C172/C172M during each working day as required to perform tests specified herein. Make test specimens in accordance with ASTM C 31/C 31M.

3.7.2 Consistency Tests

The Contractor's approved laboratory shall perform concrete slump tests in accordance with ASTM C 143/C 143M. Take samples for slump determination from concrete during placement. Perform tests at the beginning of a concrete placement operation and and for each batch (minimum) or every 20 cubic yards (maximum) of concrete to ensure that specification requirements are met. In addition, perform tests each time test beams and cylinders are made.

3.7.3 Flexural Strength Tests

The Contractor's approved laboratory shall test for flexural strength in accordance with ASTM C78/C78M. Make four test specimens for each set of tests. Test two specimens at 7 days, and the other two at 28 days. Concrete strength will be considered satisfactory when the minimum of the 28 -day test results equals or exceeds the specified 28-day flexural strength, and no individual strength test is less than 550 pounds per square inch. If the ratio of the 7-day strength test to the specified 28-day strength is less than 65 percent, make necessary adjustments for conformance. Frequency of flexural tests on concrete beams shall be not less than four test beams for each 50 cubic yards of concrete, or fraction thereof, placed. Concrete which is determined to be defective, based on the strength acceptance criteria therein, shall be removed and replaced with acceptable concrete.

3.7.4 Air Content Tests

Test air-entrained concrete for air content at the same frequency as specified for slump tests. Determine percentage of air in accordance with ASTM C231/C231M on samples taken during placement of concrete in forms.

3.7.5 Surface Testing

Surface testing for surface smoothness , edge slump and plan grade shall be performed as indicated below by the Testing Laboratory. The measurements shall be properly referenced in accordance with paving lane identification and stationing, and a report given to the Government within 24 hours after measurement is made. A final report of surface testing, signed by a Registered Engineer, containing all surface measurements and a description of all actions taken to correct deficiencies, shall be provided to the Government upon conclusion of surface testing.

3.7.5.1 Surface Smoothness Requirements

The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and all pavements shall be within the tolerances specified when checked with a 12 foot straightedge: 1/5 inch longitudinal and 1/4 inch transverse directions for roads and streets and 1/4 inch for both directions for other concrete surfaces, such as parking areas.

3.7.5.2 Surface Smoothness Testing Method

The surface of the pavement shall be tested with the straightedge to identify all surface irregularities exceeding the tolerances specified above. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines approximately 15 feet apart. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length and measuring the maximum gap between the straightedge and the pavement surface, in the area between these two high points.

3.7.6 Plan Grade Testing and Conformance

The surfaces shall vary not more than 0.06 foot above or below the plan grade line or elevation indicated. Each pavement category shall be checked by the Contractor for conformance with plan grade requirements by running lines of levels at intervals to determine the elevation at each joint intersection.

3.7.7 Test for Pavement Thickness

Measure during concrete placement to determine in-place thickness of concrete pavement.

3.7.8 Reinforcement

Inspect reinforcement prior to installation to assure it is free of loose flaky rust, loose scale, oil, mud, or other objectionable material.

3.7.9 Dowels

Inspect dowel placement prior to placing concrete to assure that dowels are of the size indicated, and are spaced, aligned and painted and oiled as specified. Dowels shall not deviate from vertical or horizontal alignment after concrete has been placed by more than 1/8 inch per foot.

3.8 WASTE MANAGEMENT

In accordance with the Waste Management Plan.

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SECTION 32 16 13

CONCRETE SIDEWALKS AND SLABS AND CURBS AND GUTTERS

PART 1 GENERAL

1.1 SUMMARY

This section covers concrete sidewalks and curbs and gutters.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM A185/A185M	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A615/A615M	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C 143/C 143M	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C 173/C 173M	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 920	Standard Specification for Elastomeric Joint Sealants

ASTM C172/C172M	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231/C231M	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM D 1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

Provide plant, equipment, machines, and tools used in the work subject to approval and maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The COR shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete

Copies of certified delivery tickets for all concrete used in the construction.

SD-06 Test Reports

Field Quality Control

Copies of all test reports within 24 hours of completion of the test.

1.5 ENVIRONMENTAL REQUIREMENTS

1.5.1 Placing During Cold Weather

Do not place concrete when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Make provisions to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F,

placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.5.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed95 degrees F at any time.

PART 2 PRODUCTS

2.1 CONCRETE

Provide concrete conforming to the applicable requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE except as otherwise specified. Concrete shall have a minimum compressive strength of 3000 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches.

2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

The concrete slump shall be 2 inches plus or minus 1 inch where determined in accordance with ASTM C 143/C 143M.

2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A615/A615M. Wire mesh reinforcement shall conform to ASTM A185/A185M.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 1/2 inch thick, unless otherwise indicated.

2.5 JOINT SEALANTS

Joint sealant, cold-applied shall conform to ASTM C 920 or ASTM D5893.

2.6 FORM WORK

Design and construct form work to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk And Slab Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees

cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted in conformance with Section 31 00 00 Earthwork.

3.1.1 Sidewalk and Slab Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks and Slabs

Set forms for sidewalks and slabs with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment shall be checked with a 10 foot straightedge. Forms shall have a transverse slope as indicated with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK AND SLAB CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks AND sLABS

Place concrete in the forms in one layer. When consolidated and finished, the sidewalks AND SLAB shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated by tamping and spading or with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 SIDEWALK AND SLAB JOINTS

Sidewalk and slab joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Expansion joints shall be formed with 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D 1752 or building paper. Joint filler shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with cold-applied joint sealant. Joint sealant shall be gray or stone in color. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length.

a. Contraction joints (except for slip forming) shall be constructed by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

b. When slip forming is used, the contraction joints shall be cut in the top portion of the gutter/curb hardened concrete in a continuous cut across the curb and gutter, using a power-driven saw. The depth of cut

shall be at least one-fourth of the gutter/curb depth and 1/8 inch in width.

3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 1/2 inch in width shall be provided at intervals not less than 30 feet nor greater than 120 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Expansion joints and the top 1 inch depth of curb and gutter contraction-joints shall be sealed with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Protect concrete against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet/gallon for the total of both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. Repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.7.4 Protective Coating

Protective coating, of linseed oil mixture, shall be applied to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Concrete

to receive a protective coating shall be moist cured.

3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be by spray application at not more than 50 square yards/gallon for first application and not more than 70 square yards/gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 50 degrees F.

3.8 FIELD QUALITY CONTROL

3.8.1 General Requirements

Perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

Provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C172/C172M. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.8.2.2 Air Content

Determine air content in accordance with ASTM C 173/C 173M or ASTM C231/C231M. ASTM C231/C231M shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air

content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

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SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A116	(2011) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A702	(1989; R 2006) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A90/A90M	(2011) Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM C94/C94M	(2011b) Standard Specification for Ready-Mixed Concrete
ASTM F1043	(2011a) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F1083	(2010) Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures
ASTM F567	(2011a) Standard Practice for Installation of Chain Link Fence
ASTM F626	(2008) Standard Specification for Fence Fittings
ASTM F883	(2009) Padlocks

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-F-191/2	(Rev E) Fencing, Wire and Post, Metal

	(Chain-Link Fence Gates)
FS RR-F-191/3	(Rev E; Am 1) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)

1.2 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fence Assembly

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1.3 ASSEMBLY AND INSTALLATION INSTRUCTIONS

Submit manufacturer's erection/installation drawings and instructions that detail proper assembly and materials in the design for fence, gate,

hardware and accessories.

Submit erection/installation drawings along with manufacturer's catalog data for complete fence assembly, gate assembly, hardware assembly and accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.5 QUALITY ASSURANCE

1.5.1 Required Report Data

Submit reports of listing of chain-link fencing and accessories regarding weight in ounces for zinc coating.

1.5.2 Certificates of Compliance

Submit certificates of compliance in accordance with the applicable reference standards and descriptions of this section for the following:

a. Zinc coating

b. PVC coating

c. Aluminum alloy coating

d. Stretcher bars

e. Gate hardware and accessories

f. Concrete

PART 2 PRODUCTS

2.1 GENERAL

Provide fencing materials conforming to the requirements of ASTM A116, ASTM A702, ASTM F626, and as specified.

Submit manufacturer's data indicating percentage of recycled material content in protective fence materials, including chain link fence, fabric, and gates to verify affirmative procurement compliance.

2.2 ZINC COATING

Provide hot-dip galvanized (after fabrication) ferrous-metal components and accessories, except as otherwise specified.

Provide zinc coating of weight not less than 1.94 ounces per square foot, as determined from the average result of two specimens, when tested in accordance with ASTM A90/A90M.

Provide zinc coating conforming to the requirements of the following:

a. Pipe: FS RR-F-191/3 Class 1 Grade A in accordance with ASTM F1083 .

b. Hardware and accessories: ASTM A153/A153M, Table 1

c. Surface: ASTM F1043

d. External: Type B-B surface zinc with organic coating,0.97 ounce per square foot minimum thickness of acrylated polymer.

e. Internal: Surface zinc coating of 0.97 ounce per square foot minimum.

Provide galvanizing repair material that is cold-applied zinc-rich coating conforming to ASTM A780/A780M.

2.3 TOP AND BOTTOM SELVAGES

Provide knuckled selvages at top and bottom for fabric with 2 inch mesh and up to 60 inches high, and if over 60 inches high, provide twisted and barbed top selvage and knuckled bottom selvage.

Knuckle top and bottom selvages for 1-3/4-inch and 1-inch mesh fabric.

2.4 POSTS , TOP RAILS , BOTTOM RAILS AND BRACES

FS RR-F-191/3 line posts; Class 1, steel pipe, Grade A or B. End, corner, and pull posts; Class 1, steel pipe, Grade A or B. Braces and rails; Class 1, steel pipe, Grade A or B.

2.5 LINE POSTS

Minimum acceptable line posts are as follows:

Up to 6-feet high:

Grade A: 1.900 inch O.D. pipe weighing 2.72 pounds per linear foot.

Grade B: 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.

Over 6-feet high:

2.0 inch O.D. pipe weighing 3.65 pounds per linear foot.

2.6 END, CORNER, AND PULL POSTS

Provide minimally acceptable end, corner, and pull posts as follows:

Up to 6 feet high:

Grade A: 2.375 inch O.D. pipe weighing 3.65 pounds per linear foot.

Grade B: 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.

Over6 feet high:

Grade A: 2.875 inch O.D. pipe weighing 5.79 pounds per linear foot.

Grade B: 2.875 inch O.D. pipe weighing 4.64 pounds per linear foot.

2.7 SLEEVES

Provide sleeves for setting into concrete construction of the same material

as post sections, sized 1-inch greater than the diameter or dimension of the post. Weld flat plates to each sleeve base to provide anchorage and prevent intrusion of concrete.

2.8 TOP RAIL

Provide Grade A weighing 2.27 pounds per linear foot. Provide expansion couplings 6-inches long at each joint in top rails.

2.9 CENTER RAILS BETWEEN LINE POSTS

For fencing over 6-feet high, provide 1.660 inches O.D. pipe center rails, Grade A weighing 2.27 pounds per linear foot

2.10 BOTTOM RAIL

Provide bottom rail conforming to minimum sizes specified in FS RR-F-191/3 for each class and grade unless members are to be oversized.

2.11 POST-BRACE ASSEMBLY

Provide bracing consisting of 1.660 inches O.D. pipe Grade A weighing 2.27 pounds per linear foot and 3/8 inch adjustable truss rods and turnbuckles.

2.12 TENSION WIRE

Provide galvanized wire, No. 7-gage, coiled spring wire. Provide zinc coating that weighs not less than 1.2 ounces per square foot.

2.13 STRETCHER BARS

Provide bars that have one-piece lengths equal to the full height of the mesh with a minimum cross section of 3/16 by 3/4 inch, in accordance with ASTM A116, ASTM A702 and ASTM F626.

2.14 POST TOPS

Provide tops that are steel, wrought iron, or malleable iron designed as a weathertight closure cap. Provide one cap for each post, unless equal protection is provided by a combination post-cap and barbed-wire supporting arm. Provide caps with an opening to permit through passage of the top rail.

2.15 STRETCHER BAR BANDS

Provide bar bands for securing stretcher bars to posts that are steel, wrought iron, or malleable iron spaced not over 15 inches on center. Bands may also be used in conjunction with special fittings for securing rails to posts. Provide bands with projecting edges chamfered or eased.

2.16 GATE POSTS

Provide a gate post for supporting each gate leaf as follows:

Over 6 feet wide and up to 13 feet wide:

2.875 inch O.D. pipe Grade A weighing 5.79 pounds per linear foot.

2.17 GATES

FS RR-F-191/2; Type I, single swing III, single cantilever sliding, wheel sliding gate . Shape and size of gate frame, as indicated in civil drawings. Framing and bracing members, round of steel alloy. Steel member finish, zinc-coated . Provide gate frames and braces of minimum sizes listed in FS RR-F-191/3 for each Class and Grade, except that steel pipe frames are a minimum of 1.90 inches o.d., 0.120 inches minimum wall thickness and aluminum pipe frames and intermediate braces are 1.869 inches o.d. minimum, 0.940 lb/ft of length. Coating for steel latches, stops, hinges, keepers, and accessories, galvanized. Provide plunger bar type gate latches. Special gate frames, as indicated. Attach gate mesh to gate frame in accordance with manufacturer's standards, except that welding is not permitted. Arrange padlocking latches to be accessible from both sides of gate, regardless of latching arrangement.

For gate leaves over 6 feet high or 6 feet wide, provide perimeter gate frames of 1.90 inch O.D. pipe Grade A weighing 2.72 pounds per linear foot.

Provide gate frame assembly that is welded or assembled with special malleable or pressed-steel fittings and rivets to provide rigid connections. Install fabric with stretcher bars at vertical edges; stretcher bars may also be used at top and bottom edges. Attach stretcher bars and fabric to gate frames on all sides at intervals not exceeding 15 inches. Attach hardware with rivets or by other means which provides equal security against breakage or removal.

Provide diagonal cross-bracing, consisting of 3/8-inch diameter adjustable-length truss rods on welded gate frames, where necessary to obtain frame rigidity without sag or twist. Provide nonwelded gate frames with diagonal bracing.

2.18 GATE HARDWARE AND ACCESSORIES

Provide gate hardware and accessories that conforms to ASTM A116, ASTM A702, ASTM F626, and be as specified:

Provide malleable iron hinges to suit gate size, non-lift-off type, offset to permit 180-degree opening.

For wheel sliding gates provide latch that permits operation from either side of the gate, with a padlock eye provided as an integral part of the latch.

Provide stops and holders of malleable iron for vehicular gates. Provide stops that automatically engage the gate and hold it in the open position until manually released.

For Single Swing gates Identified on civil plans as Man Gate on sheet C102 provide a key lock on outside face and provide a handle access NO key lock on inside of gated area.

For Single Swing gate Identified on civil plans as Card Reader Access Gate on sheet C102 provide a key lock on outside face and provide a handle access NO key lock on inside of gated area. Also provide an Electro-mechanical locking device to work with the handle and key for the card reader access gate only, which shall be solenoid actuated such that the deadbolt retracts when the solenoid is energized and remains electrically retracted until the gate is closed. Provide continuous

duty type solenoid, rated for 120V ac, 60Hz operation. The locking device shall be unlockable by Card reader as specified in section 28 20 01.00 10 "Electronic Security System" and by key on exterior side of gate and handle on interior side. Status of the electro-mechanical lock shall be monitored by two limit switches (integral to the locking device) wired in series. One switch shall monitor the deadlock lever and the other monitor the locking tongue.

2.19 MISCELLANEOUS HARDWARE

Provide miscellaneous hot-dip galvanized hardware as required.

2.20 WIRE TIES

Provide 16-gage galvanized steel wire for tying fabric to line posts,spaced 12 inches on center. For tying fabric to rails and braces, space wire ties 24 inches on center. For tying fabric to tension wire, space 0.105-inch hog rings 24 inches on center.

Manufacturer's standard procedure will be accepted if of equal strength and durability.

2.21 CONCRETE

Provide concrete conforming to ASTM C94/C94M, and obtaining a minimum 28-day compressive strength of 3,500 psi.

2.22 GROUT

Provide grout of proportions one part portland cement to three parts clean, well-graded sand and a minimum amount of water to produce a workable mix.

2.23 PADLOCKS

Provide padlocks conforming to ASTM F883, with chain.

PART 3 EXECUTION

Provide complete installation conforming to ASTM F567.

3.1 GENERAL

Ensure final grading and established elevations are complete prior to commencing fence installation.

3.2 SETTING POSTS

Remove loose and foreign materials from holes and moisten prior to placing concrete.

Provide tops of footings that are trowel finished and sloped or domed to shed water away from posts. Set hold-open devices, sleeves, and other accessories in concrete.

Keep exposed concrete moist for at least 7 calendar days after placement or cured with a membrane curing material, as approved.

Grout all posts set into sleeved holes in concrete with an approved grouting material.

Maintain vertical alignment of posts set in concrete construction until concrete has set.

3.2.1 Earth

Provide concrete bases of dimensions indicated . Compact concrete to eliminate voids, and finish to a dome shape.

3.2.2 Concrete Slabs and Walls

Set posts into zinc-coated sleeves, set in concrete slab or wall, to a minimum depth as indicated on plans. Fill sleeve joint nonshrink grout, or other approved material. Set posts for support of removable fence sections into sleeves that provide a tight sliding joint and hold posts aligned and plumb without use of lead or setting material.

3.2.3 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of fence, and a diagonal tension rod.

3.3 CONCRETE STRENGTH

Provide concrete that has attained at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 calendar days after placement, before rails, tension wire, or fabric are installed. Do not stretch fabric and wires or hang gates until the concrete has attained its full design strength.

Take samples and test concrete to determine strength as specified.

3.4 TOP RAILS

Provide top rails that run continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by the fencing manufacturer.

3.5 CENTER RAILS

Provide single piece center rails between posts set flush with posts on the fabric side, using special offset fittings where necessary.

3.6 BRACE ASSEMBLY

Provide bracing assemblies at end and gate posts and at both sides of corner and pull posts, with the horizontal brace located at midheight of the fabric.

Install brace assemblies so posts are plumb when the diagonal rod is under proper tension.

Provide two complete brace assemblies at corner and pull posts where required for stiffness and as indicated.

3.7 TENSION WIRE INSTALLATION

Install tension wire by weaving them through the fabric and tying them to

each post with not less than 7-gage galvanized wire or by securing the wire to the fabric with 10-gage ties or clips spaced 24 inches on center.

3.8 STRETCHER BAR INSTALLATION

Thread stretcher bars through or clamped to fabric 4 inches on center and secured to posts with metal bands spaced 15 inches on center.

3.9 GATE INSTALLATION

Install gates plumb, level, and secure, with full opening without interference. Install ground set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricated where necessary.

3.10 TIE WIRES

Provide tie wires that are U-shaped to the pipe diameters to which attached. Twist ends of tie wires not less than two full turns and bent so as not to present a hazard.

3.11 FASTENERS

Install nuts for tension bands and hardware on the side of the fence opposite the fabric side. Peen ends of bolts to prevent removal of nuts.

3.12 ZINC-COATING REPAIR

Clean and repair galvanized surfaces damaged by welding or abrasion, and cut ends of fabric, or other cut sections with specified galvanizing repair material applied in strict conformance with the manufacturer's printed instructions.

3.13 TOLERANCES

Provide posts that are straight and plumb within a vertical tolerance of 1/4 inch after the fabric has been stretched. Provide fencing and gates that are true to line with no more than 1/2 inch deviation from the established centerline between line posts. Repair defects as directed.

3.14 SITE PREPARATION

3.14.1 Clearing and Grading

Clear fence line of trees, brush, and other obstacles to install fencing. Establish a graded, compacted fence line prior to fencing installation.

3.15 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Secure fastening and hinge hardware in place to fence framework by peening or welding. Allow for proper operation of components. Coat peened or welded areas with a repair coating matching original coating. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.15.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10 feeton

center. Provide gate posts spaced as necessary for size of gate openings. Do not exceed 500 feet on straight runs between braced posts. Provide corner or pull posts, with bracing in both directions, for changes in direction of 15 degrees or more, or for abrupt changes in grade. Provide drawings showing location of gate, corner, end, and pull posts.

3.15.2 Top and Bottom Tension Wire

Install top and bottom tension wires before installing chain-link fabric, and pull wires taut. Place top and bottom tension wires within 8 inches of respective fabric line.

3.16 ACCESSORIES INSTALLATION

3.16.1 Post Caps

Design post caps to accommodate top rail. Install post caps as recommended by the manufacturer.

3.16.2 Padlocks

Provide padlocks for gate openings and provide chains that are securely attached to gate or gate posts. Provide padlocks keyed alike, and provide two keys for each padlock.

3.17 GROUNDING

Ground fencing as indicated on drawings.

Ground fences on each side of all gates, at each corner, at the closest approach to each building located within 50 feet of the fence, and where the fence alignment changes more than 15 degrees. Grounding locations can not exceed 650 feet. Bond each gate panel with a flexible bond strap to its gate post. Ground fences crossed by powerlines of 600 volts or more at or near the point of crossing and at distances not exceeding 150 feet on each side of crossing. Provide ground conductor consisting of No. 8 AWG solid copper wire. Provide copper-clad steel rod grounding electrodes 3/4 inch by 10 foot long. Drive electrodes into the earth so that the top of the electrode is at least 6 inches below the grade. Where driving is impracticable, bury electrodes a minimum of 12 inches deep and radially from the fence, with top of the electrode not less than 2 feet or more than 8 feet from the fence. Clamp ground conductor to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. Total resistance of the fence to ground cannot exceed 25 ohms

3.18 CLEANUP

Remove waste fencing materials and other debris from the work site.

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SECTION 33 05 23.13

UTILITY HORIZONTAL DIRECTIONAL DRILLING

PART 1 GENERAL

1.1 SUMMARY

This section covers directional drilling systems, equipment, piping and procedures.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.652	Safety and Health Regulations for Construction; Subpart P, Excavations; Requirements for Protective Systems

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Statement of Qualifications and Records or previous similar jobs.

Submit Soil Test Data prior to commencement of drilling/excavation work.

SD-02 Shop Drawings

Record Drawings

SD-03 Product Data

Submit Manufacturer's Catalog Data for the polyethylene pipe.

SD-07 Certificates

Drill Rod

SD-08 Manufacturer's Instructions

Material Safety Data Sheets

SD-11 Closeout Submittals

Work Complete Logs of Guided Directional Drill Operations

1.4 COMMENCEMENT, DELIVERY, STORAGE, AND HANDLING OF MATERIALS

Prior to commencement of the work, submit the following to the Engineer of Record for review and approval:

Manufacturer's Catalog Data

Material Safety Data Sheets

Statement of Qualifications and Records

Soil Test Data

Provide written documentation of conformance with 180ASTM D1557. Submit a complete list of all drilling fluids, additives, and mixtures to be used along with Material Safety Data Sheets.

Inspect materials delivered to the site for damage. All materials found during inspection or during the progress of work to have cracks, flaws, surface abrasions, or other defects will be rejected. Remove defective materials from the job site.

Disposal of fluids is the responsibility of the Contractor. Dispose of fluids in a manner that is in compliance with all permits and applicable federal, state, and local regulations. The Contractor may dispose of the drilling fluids on approved land owned by the Government subject to written approval from the COR. Spread the drilling slurry over the Government-approved disposal area and plow into the soil.

1.5 QUALIFICATIONS

Ensure that Contractor and his field supervisor assigned to this project are experienced in work of this nature and have successfully completed similar projects of similar length, pipe type, pipe size, and soil type using directional drilling in the last three (3) years. As part of the bid submission, submit a description of such project(s) which include, at a minimum, a listing of the location(s), date of project(s), owner, pipe type, size installed, length of installation, type, and manufacturer of equipment used, and other information relevant to the successful completion of the project.

1.6 SAFETY

Include in directional drilling equipment machine safety requirements a common grounding system to prevent electrical shock in the event of underground electrical cable strike. Ensure the grounding system connects all pieces of interconnecting machinery; the drill, mud mixing system, drill power unit, drill rod trailer, operators booth, worker grounding mats, and any other interconnected equipment to a common ground. Equip the drill with an "electrical strike" audible and visual warning system that notifies the system operators of an electrical strike.

PART 2 PRODUCTS

2.1 DRILL ROD

Select the appropriate drill rod to be used.Submit certified statement that the drill rod has been inspected and is in satisfactory condition for its intended use.

2.2 PRODUCT

Install piping as indicated on the Drawings or as approved by the COR.

2.3 DRILLING FLUIDS

Use a high quality bentonite drilling fluid to ensure hole stability, cuttings transport, bit and electronics cooling, and hole lubrication to reduce drag on the drill pipe and the product pipe. Use only fluid with a composition which complies with all federal, state, and local environmental regulations.

Mix the bentonite drilling fluid with potable water (of proper pH) to ensure no contamination is introduced into the soil during the drilling, reaming, or pipe installation process. The Contractor is responsible for any required pH adjustments.

Disposal of the drilling fluids is the responsibility of the Contractor. Conduct disposal in compliance with all relative environmental regulations, right-of-way and work space agreements, and permit requirements.

Collect drilling fluid returns in the entrance pit, exit pit, or spoils recovery pit. Immediately clean up any drilling fluid spills or overflows from these pits.

PART 3 EXECUTION

3.1 DRILL SET-UP AREA

The Contractor is responsible for design and construction of the drill entrance and exit pits.

3.2 DRILL ENTRANCE AND EXIT PITS

Drill entrance and exit pits are required. Maintain at minimum size to allow only the minimum amount of drilling fluid storage prior to transfer to mud recycling or processing system or removal from the site.

Do not allow drilling mud to flow freely on the site or around the entrance or exit pits. Remove spilled mud and restore ground to original condition. Provide shore pits in compliance with OSHA Standards, 29 CFR 1926.652.

When drilling near wetlands or water courses, provide secondary containment to prevent drilling fluids from entering the wetlands, and secure written approval of secondary containment plan from the COR .

3.3 DRILL ENTRANCE AND EXIT ANGLE

Ensure entrance and exit angles and elevation profile maintains adequate cover to reduce risk of drilling fluid breakouts and ground exit occurs as

specified herein. Ensure that entrance and exit angles ensure pullback forces do not exceed 5 percent strain on the polyethylene pipe.

3.4 PILOT HOLE

The type and size of the pilot string cutting head and the diameter of the drill pipe is at the Contractor's discretion.

Drill the pilot hole along the path shown on the plan and profile drawings. Pilot hole tolerances are as follows:

a. Vertical Tolerance: Provide minimum cover below channel bottom as specified on the plans. The Contractor may go deeper if necessary to prevent breakout.

b. Horizontal Tolerance: plus/minus - 60 inches from the centerline of the product pipe.

c. Curve Radius: No curve is acceptable with a radius less than 1,000 feet.

d. Entry Point Location: Make pilot hole entry point within plus/minus - 60 inches of the location shown on the drawings or as directed by the COR in the field.

e. Exit Point Location: Make the exit point location within plus/minus - 60 inches of the location shown on the drawings or as directed by the COR in the field.

f. The installed pipeline cover requirements as shown on the drawings or as specified is mandatory.

3.5 REAMING

Conduct reaming operations at the Contractor's discretion. Determine the type of back reamer to be utilized by the type of subsurface soil conditions that are encountered during the pilot hole drilling operation. The reamer type is at the Contractor's discretion.

3.6 PULL BACK

Fully assemble the entire pipeline to be installed via direction drill prior to commencement of pull back operations.

Support the pipeline during pullback operations in a manner to enable it to move freely and prevent damage. Install the pipeline in one continuous pull.

Minimize torsion stress by using a swivel to connect the pull section to the reaming assembly.

Maximum allowable tensile force imposed on the pull section is not to exceed 90 percent of the pipe manufacturer's safe pull (or tensile) strength. If the pull section is made up of multiple pipe size or materials, the lowest safe pull strength value governs and the maximum allowable tensile force is not to exceed 90 percent of this value.

Minimize external pressure during installation of the pullback section in the reamed hole. Replace damaged pipe resulting from external pressure at no cost to the Government. Buoyancy modification is at the discretion of

the Contractor.

3.7 CONNECTION OF PRODUCT PIPE TO WATER LINE

After the product pipe has been successfully installed, allow the product pipe to recover for 24 hours prior to connection of the water line. The Contractor is responsible for ensuring that a sufficient length of the product pipe has been pulled through the hole so that the pull-nose is not pulled back into bore hole due to stretch recovery of the product pipe.

3.8 GUIDANCE SYSTEMS

Walkover guidance systems are not acceptable for this project; use a magnetic survey tool locator installed behind the pilot string cutting head and an electric grid (tru-tracker) system for this project.

3.9 DOCUMENTATION

Maintain drilling logs that accurately provide drill bit location (both horizontally and vertically) at least every 2 inches along the drill path. In addition, keep logs that record, as a minimum the following, every 15 minutes throughout each drill pass, back ream pass, or pipe installation pass:

a. Drilling Fluid Pressure

b. Drilling Fluid Flow Rate

c. Drill Thrust Pressure

d. Drill Pullback Pressure

e. Drill Head Torque

Make all instrumentation, readings, and logs available to the COR at all times during operation.

3.10 UTILITY LOCATING AND MARKING

Locate and clearly mark all utilities prior to start of excavation or drilling. The Contractor is responsible for damage to utilities, and repairs for such damages, at no cost to the Government.

3.11 CLEANUP AND FINAL CLOSEOUT

Immediately upon completion of work of this section, remove all rubbish and debris from the job site. Remove all construction equipment and implements of service leaving the entire area involved in a neat condition acceptable of the COR .

Immediately clean "blow holes" or "breakouts" of drilling fluid to the surface and return the surface area to its original condition. Dispose of all drilling fluids, soils, and separated materials in compliance with federal, state, and local environmental regulations.

Submit an electronic copy and three hard copies of the record drawings to the COR within five days after completing the pull back. Include in the record drawings a plan, profile, and all information recorded during the progress of the work. Clearly tie the record drawings to the project's

survey control. Maintain and submit upon completion signed final work complete logs of guided directional drill operations.

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WATER DISTRIBUTION

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This section covers potable and nonpotable (raw water and sea or salt water) systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	Hypochlorites
AWWA B301	Liquid Chlorine
AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153/A21.53	Ductile-Iron Compact Fittings for Water Service
AWWA C203	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C500	Metal-Seated Gate Valves for Water Supply Service
AWWA C504	Standard for Rubber-Seated Butterfly Valves

AWWA C508	Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS
AWWA C509	Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C605	Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C606	Grooved and Shouldered Joints
AWWA C651	Standard for Disinfecting Water Mains
AWWA C800	Underground Service Line Valves and Fittings
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
AWWA C901	Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13mm) Through 3 In. (76 mm), for Water Service
AWWA M23	Manual: PVC Pipe - Design and Installation

ASME INTERNATIONAL (ASME)

ASME B16.1	Gray Iron Threaded Fittings; Classes 25, 125 and 250
ASME B16.26	Standard for Cast Copper Alloy Fittings for Flared Copper Tubes

ASTM INTERNATIONAL (ASTM)

ASTM A536	Standard Specification for Ductile Iron Castings
ASTM B32	Standard Specification for Solder Metal
ASTM B61	Standard Specification for Steam or Valve Bronze Castings
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM C 94/C 94M	Standard Specification for Ready-Mixed Concrete
ASTM D 1785	Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120

ASTM D 2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2657	Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D 2774	Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3139	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F 402	Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 704	Standard System for the Identification of the Hazards of Materials for Emergency Response

UNDERWRITERS LABORATORIES (UL)

UL 262	Gate Valves for Fire-Protection Service
UL 312	Check Valves for Fire-Protection Service

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3	Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch)

1.3 UNIT PRICES

Measurement and payment will be based on completed work performed in accordance with the drawings, specifications, and the contract payment schedules. Payment will not be made under this section for excavation, trenching, or backfilling.

1.3.1 Measurement

The length of water lines to be paid for will be determined by measuring along the centerlines of the various sizes of pipe furnished and installed. Pipe will be measured from center of fitting to center of fitting, from center of water distribution line to end of service connection, and from center of water distribution line to center of hydrant. No deduction will be made for the space occupied by valves or fittings.

1.3.2 Payment

Payment will be made for water lines at the contract unit price per linear foot for the various types and sizes of water lines, and will be full compensation for all pipes, joints, specials, and fittings, complete in place. Payment for fire hydrants, gate valves, valve boxes, and standard valve manholes will be made at the respective contract unit price each for such items complete in place. Payment will include the furnishing of all testing, plant, labor, and material and incidentals necessary to complete the work, as specified and as shown.

1.4 DESIGN REQUIREMENTS

1.4.1 Water Distribution Mains

Provide water distribution mains indicated as 6 inch lines of polyvinyl chloride (PVC) plastic or pipe. Provide water main accessories, gate valves as specified and where indicated. Submit design calculations of water piping.

1.4.2 Water Service Lines

Provide water service lines indicated as 6 inch lines from water distribution main to building service at a point approximately 5 feet from building . Water service lines shall be polyvinyl chloride (PVC) plastic pipe . polyvinyl chloride (PVC) plastic pipe appurtenances, and valves as specified for water mains may also be used for service lines. Provide water service line appurtenances as specified . Submit design calculations of water piping.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Piping Materials

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Corporation stops

Valve boxes

Submit manufacturer's standard drawings or catalog cuts, except

submit both drawings and cuts for push-on and rubber-gasketed bell-and-spigot joints. Include information concerning gaskets with submittal for joints and couplings.

SD-05 Design Data

Design calculations of water piping

SD-06 Test Reports

Bacteriological Disinfection.

Test results from commercial laboratory verifying disinfection

SD-07 Certificates

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Shop-applied lining

Lining

Compound Type Meters

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

SD-08 Manufacturer's Instructions

Delivery, storage, and handling

Installation procedures for water piping

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves free of dirt and debris.

1.6.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place any other

material or pipe inside a pipe or fitting after the coating has been applied. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

1.6.2.1 Coated and Wrapped Steel Pipe

1.6.2.2 Polyethylene (PE) Pipe, Fittings, and Accessories

Handle PE pipe, fittings, and accessories in accordance with AWWA C901.

1.6.2.3 Miscellaneous Plastic Pipe and Fittings

Handle Polyvinyl Chloride (PVC), pipe and fittings in accordance with the manufacturer's recommendations. Store plastic piping and jointing materials that are not to be installed immediately under cover out of direct sunlight.

Storage facilities shall be classified and marked in accordance with NFPA 704.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping

a. Pipe and Fittings: Pipe, except flanged pipe, AWWA C151/A21.51, Pressure Class C150. Flanged pipe, AWWA C115/A21.15. Fittings, AWWA C110/A21.10 or AWWA C153/A21.53 ; fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, standard thickness.

b. Joints and Jointing Material:

1. Joints: Joints for pipe and fittings shall be push-on joints or mechanical joints .

2. Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111/A21.11.

3. Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

4. Flanged Joints: Bolts, nuts, and gaskets for flanged connections as recommended in the Appendix to AWWA C115/A21.15. Flange for

setscrewed flanges shall be of ductile iron, ASTM A536, Grade 65-45-12, and conform to the applicable requirements of ASME B16.1, Class 250. Setscrews for setscrewed flanges shall be 190,000 psi tensile strength, heat treated and zinc-coated steel. Gasket and lubricants for setscrewed flanges, in accordance with applicable requirements for mechanical-joint gaskets specified in AWWA C111/A21.11. Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

5. Insulating Joints: Designed to effectively prevent metal-to-metal contact at the joint between adjacent sections of piping. Joint shall be of the flanged type with insulating gasket, insulating bolt sleeves, and insulating washers. Gasket shall be of the dielectric type, full face, and in other respects as recommended in the Appendix to AWWA C115/A21.15. Bolts and nuts, as recommended in the Appendix to AWWA C115/A21.15.

6. Sleeve-Type Mechanical Coupled Joints: As specified in paragraph entitled "Sleeve-Type Mechanical Couplings."

7. Type Joints: pipe ends and couplings, AWWA C606. Joint dimension shall be as specified in AWWA C606 for rigid joints .

2.1.1.2 Polyvinyl Chloride (PVC) Plastic Piping

a. Pipe and Fittings: Pipe, AWWA C900, shall be plain end or gasket bell end, Pressure Class 150 (DR 18) with cast-iron-pipe-equivalent OD.

b. Fittings for PVC pipe: Fittings shall be gray iron or ductile iron, AWWA C110/A21.10 or AWWA C153/A21.53, and have cement-mortar lining, AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with PVC plastic pipe specified in this paragraph. Iron fittings and specials shall be cement-mortar lined in accordance with AWWA C104/A21.4. Fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C605 and AWWA C900.

c. Joints and Jointing Material: Joints for pipe shall be push-on joints, ASTM D 3139. Joints between pipe and metal fittings, valves, and other accessories shall be push-on joints ASTM D 3139, or compression-type joints/mechanical joints, ASTM D 3139 and AWWA C111/A21.11. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe, ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, AWWA C111/A21.11, respectively, for push-on joints and mechanical joints. Mechanically coupled joints using a sleeve-type mechanical coupling, as specified in paragraph entitled "Sleeve-Type Mechanical Couplings," may be used as an optional jointing method in lieu of push-on joints on plain-end PVC plastic pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling and to the use of internal stiffeners as specified for compression-type joints in ASTM D 3139.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Gate Valves

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be nonrising stem type with double-disc gates and mechanical-joint ends or push-on joint ends as appropriate for the adjoining pipe, (2) AWWA C509 shall be nonrising stem type with mechanical-joint ends or resilient-seated gate valves 3 to 12 inches in size, and (3) UL 262 shall be inside-screw type with operating nut, double-disc or split-wedge type gate, designed for a hydraulic working pressure of 150 psi, and shall have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals . Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. In lieu of mechanical-joint ends and push-on joint ends, valves may have special ends for connection to sleeve-type mechanical coupling. Valve ends and gaskets for connection to sleeve-type mechanical coupling shall conform to the applicable requirements specified for the joint or coupling. Valves shall be of one manufacturer.

2.1.2.2 Gate Valves

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be outside-screw-and-yoke rising-stem type with double-disc gates and flanged ends, (2) AWWA C509 shall be outside-screw-and-yoke rising-stem type with flanged ends, and (3) UL 262 shall be outside-screw-and-yoke type, shall have solid or one-piece type gate and flanged ends, and shall be designed for a hydraulic working pressure of psi. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Provide valves with handwheels that open by counterclockwise rotation of the valve stem. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. In lieu of flanged ends, valves may have shouldered ends suitable for shouldered type joints, as specified in paragraph entitled "Ductile-Iron Piping." Valves shall be of one manufacturer.

2.1.2.3 Check Valves

Swing-check type, AWWA C508 or UL 312. Valves conforming to: (1) AWWA C508 shall have iron or steel body and cover and flanged ends, and (2) UL 312 shall have cast iron or steel body and cover, flanged ends, and designed for a working pressure of psi. Materials for UL 312 valves shall conform to the reference standards specified in AWWA C508. Valves shall have clear port opening. In lieu of flanged ends, valves may have shouldered ends suitable for shouldered type joints, as specified in paragraph entitled "Ductile-Iron Piping." Valves shall be of one manufacturer.

2.1.2.4 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves shall conform to the performance requirements of AWWA C504. Wafer type valves conforming to the performance requirements of AWWA C504 in all respects, but not meeting laying length requirements will be acceptable if supplied and installed with a spacer providing the specified laying length. All tests required by AWWA C504 shall be met. Flanged-end valves shall be installed in an approved pit and provided with a union or sleeve-type coupling in the pit to permit

removal. Mechanical-end valves 3 through 10 inches in diameter may be direct burial if provided with a suitable valve box, means for manual operation, and an adjacent pipe joint to facilitate valve removal. Valve operators shall restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

2.1.2.5 Pressure Reducing Valves

Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. Valves shall be suitable for psi operating pressure on the inlet side, with outlet pressure set for psi. The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type, designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be flanged. Valve bodies shall be bronze, cast iron or cast steel with bronze trim. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts.

2.1.2.6 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

2.1.2.7 Tracer Wire for Nonmetallic Piping

Provide bare copper or aluminum wire not less than 0.10 inch in diameter in sufficient length to be continuous over each separate run of nonmetallic pipe.

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Piping Materials

2.2.1.1 Plastic Piping

Plastic pipe and fittings shall bear the seal of the National Sanitation Foundation (NSF) for potable water service. Plastic pipe and fittings shall be supplied from the same manufacturer.

b. Polyvinyl Chloride (PVC) Plastic Piping with Elastomeric-Gasket Joints:

   Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 40, with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified.

c. Polyvinyl Chloride (PVC) Plastic Piping with Solvent Cement Joints:

   Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure.

d. Polyethylene (PE) Plastic Pipe: Pipe tubing, and heat fusion fitting shall conform to AWWA C901.

e. Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe: AWWA C909, plain end or gasket bell end, Pressure Class 150 with cast iron pipe equivalent outside diameter.

2.2.1.2 Insulating Joints

Joints between pipe of dissimilar metals shall have a rubber-gasketed or other suitable approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact between adjacent sections of piping.

2.2.2 Water Service Line Appurtenances

2.2.2.1 Corporation Stops

Ground key type; bronze, ASTM B61 or ASTM B62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME B16.26.

2.2.2.2 Curb or Service Stops

Ground key, round way, inverted key type; made of bronze, ASTM B61 or ASTM B62; and suitable for the working pressure of the system. Ends shall be as appropriate for connection to the service piping. Arrow shall be cast into body of the curb or service stop indicating direction of flow.

2.2.2.3 Service Clamps

Service clamps used for repairing damaged cast-iron, steel, PVC or asbestos-cement pipe shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.2.2.4 Goosenecks

Type K copper tubing. Joint ends for goosenecks shall be appropriate for connecting to corporation stop and service line. Length of goosenecks shall be in accordance with standard practice.

2.2.2.5 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.2.2.6 Check Valves

Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The

size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve. Valves 2 inches and larger shall be outside lever and spring type.

Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

2.2.2.7 Gate Valves 3 Inch Size and Larger

Gate valves 3 inch size and larger on buried piping AWWA C500 or UL 262 and of one manufacturer. Valves, AWWA C500, nonrising stem type with double-disc gates. Valves, UL 262, inside-screw type with operating nut, split wedge or double disc type gate, and designed for a hydraulic working pressure of 175 psi. Materials for UL 262 valves conforming to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals and shall be bolted and constructed so as to permit easy removal of parts for repair.

2.2.2.8 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Terminate the work covered by this section at a point approximately 5 feet from the building , unless otherwise indicated. Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer horizontally than 10 feet from any sewer line.

Where water piping is required to be installed within 1 m 3 feet of existing structures, the water pipe shall be sleeved as required in Paragraph "Casting Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

a. Water Piping Installation Parallel With Sewer Piping

1. Normal Conditions: Lay water piping at least 10 feet horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

2. Unusual Conditions: When local conditions prevent a horizontal separation of 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom (invert) of the water piping shall be at least 18 inches above the top (crown) of the sewer piping.

(b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling. Approved waste water disposal method shall be utilized.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of Water Piping Crossing Sewer Piping

1. Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping.

2. Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.

(b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 20 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

c. Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00.

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe in a neat workmanlike manner accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate

recesses to accommodate bells, joints, and couplings. Provide anchors and supports where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. Depth of cover over top of pipe shall not be less than 2 1/2 feet.

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped .

3.1.1.6 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.1.7 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly.

b. Allowable Deflection: The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage . Thrust blocks shall be in accordance with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94/C 94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive

strength.

3.1.2.2 Installation of PVC Plastic Water Main Pipe

Installation of PVC Plastic Water Main Pipe and Associated Fittings: Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines"; with the requirements of UBPPA UNI-B-3 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Jointing: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of UBPPA UNI-B-3 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint; assemble in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.

b. Offset: Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the CO, but shall not exceed 5 degrees.

c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Thrust blocks shall be in accordance with the requirements of UBPPA UNI-B-3 for reaction or thrust blocking and plugging of dead ends, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94/C 94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

d. Fittings: Install in accordance with AWWA C605.

3.1.2.3 Installation of Polyethylene (PE) Plastic Piping

a. General Installation:

PE pipes shall be installed in accordance with ASTM D 2774.

b. Jointing:

Jointing shall comply with ASTM D 2657, Technique I-Socket Fusion or Technique II-Butt Fusion.

c. Offsets:

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the CO, but shall not exceed 5 degrees.

3.1.2.4 Installation of Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Piping

a. General Installation:

Install PVCO Pressure piping in accordance with AWWA C605.

b. Jointing:

As required for PVC piping.

c. Anchorage:

As required for PVC piping.

d. Offsets:

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the CO, but shall not exceed 5 degrees.

3.1.2.5 Installation of Valves:

TextInstall gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Install gate valves on PVC water mains in accordance with the recommendations for appurtenance installation in AWWA M23, Chapter 7, "Installation." Install check valves in accordance with the applicable requirements of AWWA C600 for valve-and-fitting installation , except as otherwise indicated. Make and assemble joints to gate valves and check valves as specified for making and assembling the same type joints between pipe and fittings.
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3.1.3 Installation of Water Service Piping

3.1.3.1 Location

Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines approximately 5 feet from the building line at a point directed by the CO ; such water service lines shall be closed with plugs or caps.

3.1.4 Special Requirements for Installation of Water Service Piping

3.1.4.1 Installation of Metallic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of AWWA C600 for pipe installation, unless otherwise specified.

a. Jointing:

1. Screwed Joints: Make screwed joints up tight with a stiff mixture of graphite and oil, inert filler and oil, or graphite compound; apply to male threads only. Threads shall be full cut; do not leave more than three threads on the pipe exposed after assembling the joint.

2. Joints for Copper Tubing: Cut copper tubing with square ends; remove fins and burrs. Handle tubing carefully; replace dented, gouged, or otherwise damaged tubing with undamaged tubing. Make solder joints using ASTM B32, 95-5 tin-antimony or Grade Sn96 solder. Solder and flux shall contain not more than 0.2 percent lead. Before making joint, clean ends of tubing and inside of fitting or coupling with wire brush or abrasive. Apply a rosin flux to the tubing end and on recess inside of fitting or coupling. Insert tubing end into fitting or coupling for the full depth of the recess and solder. For compression joints on flared tubing, insert tubing through the coupling nut and flare tubing.

3. Flanged Joints: Make flanged joints up tight, taking care to avoid undue strain on flanges, valves, fittings, and accessories.

b. Protection of Buried Steel Service Line Piping: Unless otherwise specified, prepare, prime, and coat exterior surface of zinc-coated steel pipe and associated fittings to be buried with hot-applied coal-tar enamel with a bonded single layer of felt wrap in accordance with AWWA C203 . For the felt wrap material, use fibrous-glass mat as specified in AWWA C203; use of asbestos felt will not be permitted. Use solvent wash only to remove oil, grease, and other extraneous matter from zinc-coated pipe and fittings.

3.1.4.2 Installation of Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of ASTM D 2774 and ASTM D 2855, unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F 402.

a. Jointing: Make solvent-cemented joints for PVC plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with ASTM D 2855. Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

b. Plastic Pipe Connections to Appurtenances: Connect plastic pipe service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.1.4.3 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

3.1.5 Disinfection

Prior to disinfection, obtain CO approval of the proposed method for disposal of waste water from disinfection procedures. Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 and 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplying nonpotable water is not required.

3.1.6 Optional Disinfection Method

Disinfect new potable water lines and affected portions of existing potable water lines with geothermal water. Geothermal water shall be not less than 90 degrees Celsius and contact time shall be not less than 30 minutes. After disinfection, thoroughly flush new potable water lines and affected portions of existing potable water lines with the chlorinated base water supply for a minimum of two hours.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

Prior to hydrostatic testing, obtain CO approval of the proposed method for disposal of waste water from hydrostatic testing. The CO will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing . The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test PVC plastic water mains and water service lines made with PVC plastic water main pipe in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water main pipe shall not exceed the amounts given in UBPPA UNI-B-3, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed. Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at plastic pipe joints.

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 inches in diameter, hydrostatic test pressure shall be not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

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SECTION 33 11 23

NATURAL GAS PIPING

PART 1 GENERAL

1.1 SUMMARY

This section covers exterior and interior fuel gas piping.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.41/CSA 6.9	Quick-Disconnect Devices for Use with Gas Fuel Appliances
ANSI Z21.45	Flexible Connectors of Other Than All-Metal Construction for Gas Appliances

ASME INTERNATIONAL (ASME)

ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.3	Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.39	Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	Standard for Square and Hex Nuts

ASME B31.8	Gas Transmission and Distribution Piping Systems
ASME BPVC SEC VIII D1	BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A193/A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM D 2513	Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D 2683	Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	National Fuel Gas Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	Color Code for Pipelines & for Compressed Gas Cylinders

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

1.3 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS applies to

this section, with additions and modifications specified herein.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Valve box

Pressure regulator

Gas equipment connectors

Valves

Warning and identification tape

Risers

Transition fittings

Gas meter

SD-07 Certificates

Welder's qualifications

PE welder's qualifications

Welder's identification symbols

SD-08 Manufacturer's Instructions

PE pipe and fittings

Submit manufacturer's installation instructions and manufacturer's visual joint appearance chart.

1.5 QUALITY ASSURANCE

1.5.1 Welder's Qualifications

Comply with ASME B31.8. The steel welder shall have a copy of a certified ASME B31.8 qualification test report. The PE welder shall have a certificate from a PE pipe manufacturer's sponsored training course. Contractor shall also conduct a qualification test. Submit each welder's identification symbols, assigned number, or letter, used to identify work of the welder. Affix symbols immediately upon completion of welds. Welders making defective welds after passing a qualification test shall be given a requalification test and, upon failing to pass this test, shall not be permitted to work this contract.

1.5.2 PE Welder's Qualifications

Prior to installation, Contractor shall have supervising and installing personnel trained by a PE pipe manufacturer's sponsored course of not less than one week duration, or present proof satisfactory to the COR that

personnel are currently working in the installation of PE gas distribution lines.

1.5.3 Safety Standards

49 CFR 192.

1.6 DELIVERY, STORAGE, AND HANDLING

Handle, transport, and store plastic pipe and fittings carefully. Plug or cap pipe ends during transportation or storage to minimize dirt and moisture entry. Do not subject to abrasion or concentrated external loads. Discard PE pipe sections and fittings that have been damaged.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Conform to NFPA 54 and with requirements specified herein. Supply piping to appliances or equipment shall be at least as large as the inlets thereof.

2.2 PIPE AND FITTINGS

2.2.1 Aboveground and Within Buildings and Vaults

a. Pipe: Black steel in accordance with ASTM A53/A53M, Schedule 80, threaded ends for sizes 2 inches and smaller; otherwise, plain end beveled for butt welding.

b. Threaded Fittings: ASME B16.3, black malleable iron.

c. Socket-Welding Fittings: ASME B16.11, forged steel.

d. Butt-Welding Fittings: ASME B16.9, with backing rings of compatible material.

e. Unions: ASME B16.39, black malleable iron.

f. Flanges and Flanged Fittings: ASME B16.5 steel flanges or convoluted steel flanges conforming to ASME BPVC SEC VIII D1. Flange faces shall have integral grooves of rectangular cross sections which afford containment for self-energizing gasket material.

2.2.2 Underground Polyethylene (PE)

PE pipe and fittings are as follows:

a. Pipe: ASTM D 2513, 100 psig working pressure, Standard Dimension Ratio (SDR), the ratio of pipe diameter to wall thickness, 11.5 maximum.

b. Socket Fittings: ASTM D 2683.

c. Butt-Fusion Fittings: ASTM D 2513, molded.

2.2.3 Risers

Manufacturer's standard riser, transition from plastic to steel pipe with 7 to 12 mil thick epoxy coating. Use swaged gas-tight construction with O-ring seals, metal insert, and protective sleeve. Provide remote bolt-on

or bracket riser supports as indicated.

2.2.4 Transition Fittings

a. Steel to Plastic (PE): As specified for "riser" except designed for steel-to-plastic with tapping tee or sleeve. Coat or wrap exposed steel pipe with heavy plastic coating.

2.3 SHUTOFF VALVES, BELOW GROUND

2.3.1 Metallic Ball Valves

ASME B16.33 or ASME B16.38 corrosion-resisting steel, with threaded or flanged ends. Provide polytetrafluoroethylene (PTFE) seats.

2.3.2 PE Ball or Plug Valves

ASME B16.40 and ASTM D 2513, Class C materials (PE 2306 or PE 3406), strength rating of Class 3 location with class factor of 0.25, and SDR matching PE pipe dimensions and working pressure.

2.4 VALVES ABOVEGROUND

Provide lockable valves where indicated.

2.4.1 Shutoff Valves, Sizes Larger Than 2 Inches

Steel body ball valve with flanged ends in accordance with ASME B16.38. Provide PTFE seats.

2.4.2 Shutoff Valves, Sizes 2 Inches and Smaller

Steel body ball valve in accordance with ASME B16.33, full port pattern, reinforced PTFE seals, threaded ends, and PTFE seat.

2.4.3 Pressure Regulator

Self-contained with spring-loaded diaphragm pressure regulator, psig to inches water reduction, pressure operating range as required for the pressure reduction indicated, volume capacity not less than indicated, and threaded ends for sizes 2 inches and smaller, otherwise flanged.

Earthquake Automatic Gas Shutoff Valve ASCE 25-06 and UL listed or AGA listed or International Association of Plumbing and Mechanical Officials (IAPMO) listed. The valve may be either pendulum or ball construction.

2.5 GAS METER

AGA ANSI B109.1, AGA ANSI B109.2 or AGA ANSI B109.3 pipe mounted, diaphragm or bellow style, enamel coated steel case. Provide combined register totalizer, water escape hole in SECTION 33 11 23 Page 8 02/14/12 Ames Standard Construction Specification J11008 housing, and means for sealing against tampering.

2.6 GAS EQUIPMENT CONNECTORS

a. Flexible Connectors: ANSI Z21.45.

b. Quick Disconnect Couplings: ANSI Z21.41/CSA 6.9.

c. Semi-Rigid Tubing and Fittings: ANSI Z21.69/CSA 6.16.

2.7 VALVE BOX

Provide street valve box with cast-iron cover and two-piece 5 1/4 inch shaft-slip valve box extension or rectangular concrete valve box, sized large enough for removal of valve without removing box. Cast the word "Gas" into the box cover. Use valve box for areas as follows:

a. Roads and Traffic Areas: Heavy duty, cast iron cover.

b. Other Areas: Standard duty, concrete cover.

2.8 CASING

Where indicated at railroad or other crossing, provide ASTM A53, galvanized pipe, Schedule 40.

2.9 BURIED UTILITY WARNING AND IDENTIFICATION TAPE

Provide detectable aluminum-foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3 inch minimum width, color-coded yellow for natural gas, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be "CAUTION BURIED GAS PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.10 HANGERS AND SUPPORTS

MSS SP-58, as required by MSS SP-69.

2.11 WELDING FILLER METAL

ASME B31.8.

2.12 PIPE-THREAD TAPE

Antiseize and sealant tape of polytetrafluoroethylene (PTFE).

2.13 BOLTING (BOLTS AND NUTS)

Stainless steel bolting; ASTM A193/A193M, Grade B8M or B8MA, Type 316, for bolts; and ASTM A194/A194M, Grade 8M, Type 316, for nuts. Dimensions of bolts, studs, and nuts shall conform with ASME B18.2.1and ASME B18.2.2 with coarse threads conforming to ASME B1.1, with Class 2A fit for bolts and studs and Class 2B fit for nuts. Bolts or bolt-studs shall extend through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Bolts shall have American Standard regular square or heavy hexagon heads; nuts shall be American Standard heavy semifinished hexagonal.

2.14 GASKETS

Fluorinated elastomer, compatible with flange faces.

2.15 IDENTIFICATION FOR ABOVEGROUND PIPING

MIL-STD-101 for legends and type and size of characters. For pipes 3/4 inch od and larger, provide printed legends to identify contents of pipes and arrows to show direction of flow. Color code label backgrounds to signify levels of hazard. Make labels of plastic sheet with pressure-sensitive adhesive suitable for the intended application. For pipes smaller than 3/4 inch od, provide brass identification tags 1 1/2 inches in diameter with legends in depressed black-filled characters.

PART 3 EXECUTION

3.1 INSTALLATION

Install gas piping, appliances, and equipment in accordance with NFPA 54.

3.1.1 Excavating and Backfilling

Perform excavating and backfilling of pipe trenches as specified in Section 31 00 00 EARTHWORK. Place pipe directly in trench bottom and cover with minimum 3 inches of sand to top of pipe. If trench bottom is rocky, place pipe on a 3 inch bed of sand and cover as above. Provide remaining backfilling. Coordinate provision of utility warning and identification tape with backfill operation. Bury utility warning and identification tape with printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.1.2 Piping

Cut pipe to actual dimensions and assemble to prevent residual stress. Provide supply connections entering the buildings as indicated. Within buildings, run piping parallel to structure lines and conceal in finished spaces. Terminate each vertical supply pipe to burner or appliance with tee, nipple and cap to form a sediment trap. To supply multiple items of gas-burning equipment, provide manifold with inlet connections at both ends.

3.1.2.1 Cleanliness

Clean inside of pipe and fittings before installation. Blow lines clear using 80 to 100 psig clean dry compressed air. Rap steel lines sharply along entire pipe length before blowing clear. Cap or plug pipe ends to maintain cleanliness throughout installation.

3.1.2.2 Aboveground Steel Piping

Determine and establish measurements for piping at the job site and accurately cut pipe lengths accordingly. For 2 inch diameter and smaller, use threaded or socket-welded joints. For 2 1/2 inch diameter and larger, use flanged or butt-welded joints.

a. Threaded Joints: Where possible use pipe with factory-cut threads, otherwise cut pipe ends square, remove fins and burrs, and cut taper pipe threads in accordance with ASME B1.20.1. Provide threads smooth, clean, and full-cut. Apply anti-seize paste or tape to male threads portion. Work piping into place without springing or forcing. Backing off to permit alignment of threaded joints will not be permitted. Engage threads so that not more than three threads remain exposed. Use unions for connections to for which a means of disconnection is not otherwise provided.

b. Welded Joints: Weld by the shielded metal-arc process, using covered electrodes and in accordance with procedures established and qualified in accordance with ASME B31.8.

c. Flanged Joints: Use flanged joints for connecting welded joint pipe and fittings to valves to provide for disconnection. Install joints so that flange faces bear uniformly on gaskets. Engage bolts so that there is complete threading through the nuts and tighten so that bolts are uniformly stressed and equally torqued.

d. Pipe Size Changes: Use reducing fittings for changes in pipe size. Size changes made with bushings will not be accepted.

e. Painting: Paint new ferrous metal piping, including supports, in accordance with Section 09 90 00 PAINTS AND COATINGS. Do not apply paint until piping tests have been completed.

f. Identification of Piping: Identify piping aboveground in accordance with MIL-STD-101, using adhesive-backed or snap-on plastic labels and arrows. In lieu of labels, identification tags may be used. Apply labels or tags to finished paint at intervals of not more than 50 feet. Provide two copies of the piping identification code framed under glass and install where directed.

3.1.2.3 Buried Plastic Lines

Provide totally PE piping. Prior to installation, obtain printed instructions and technical assistance in proper installation techniques from pipe manufacturer.

a. PE Piping: Prior to installation, Contractor shall have supervising and installing personnel, certified in accordance with paragraph entitled "Welder's Qualifications." Provide fusion-welded joints except where transitions have been specified. Use electrically heated tools, thermostatically controlled and equipped with temperature indication. (Where connection must be made to existing plastic pipe, contractor shall be responsible for determination of compatibility of materials and procedural changes in fusion process necessary to attain maximum integrity of bond.)

b. Laying PE Pipe: Bury pipe 24 inches below finish grade . Lay in accordance with manufacturer's printed instructions.

3.1.2.4 Connections to Existing Pipeline

When making connections to live gas mains, use pressure tight installation equipment operated by workmen trained and experienced in making hot taps. For connections to existing underground pipeline or service branch, use transition fittings for dissimilar materials.

3.1.2.5 Wrapping

Where connection to existing steel line is made underground, tape wrap new steel transition fittings and exposed existing pipe having damaged coating. Clean pipe to bare metal. Initially stretch first layer of tape to conform to the surface while spirally half-lapping. Apply a second layer, half-lapped and spiraled as the first layer, but with spirals perpendicular to first wrapping. Use 10 mil minimum thick polyethylene tape. In lieu of

tape wrap, heat shrinkable 10 mil minimum thick polyethylene sleeve may be used.

3.1.3 Valves

Install valves approximately at locations indicated. Orient stems vertically, with operators on top, or horizontally. Provide support for valves to resist operating torque applied to PE pipes.

3.1.3.1 Pressure Regulator

Provide ball valve ahead of regulator. Install regulator outside of building and 18 inches aboveground on riser. Install gas meter in conjunction with pressure regulator. On outlet side of regulator, provide a union and a 3/8 inch gage tap with plug.

3.1.3.2 Stop Valve and Shutoff Valve

Provide stop valve on service branch at connection to main and shut-off valve on riser outside of building.

3.1.4 Pipe Sleeves

Where piping penetrates concrete or masonry wall, floor or firewall, provide pipe sleeve poured or grouted in place. Make sleeve of steel or cast-iron pipe of such size to provide 1/4 inch or more annular clearance around pipe. Extend sleeve through wall or slab and terminate flush with both surfaces. Pack annular space with oakum, and caulk at ends with silicone construction sealant.

3.1.5 Piping Hangers and Supports

Provide seismic restraints in accordance with SMACNA 1981.

3.1.6 Final Connections

Make final connections to equipment and appliances using rigid pipe and fittings, except for the following:

3.1.6.1 Domestic Water Heaters

Connect with AGA-Approved semi-rigid tubing and fittings.

3.2 FIELD QUALITY CONTROL

3.2.1 Metal Welding Inspection

Inspect for compliance with NFPA 54and ASME B31.8. Replace, repair, and then re-inspect defective welds.

3.2.2 PE Fusion Welding Inspection

Visually inspect butt joints by comparing with, manufacturer's visual joint appearance chart. Inspect fusion joints for proper fused connection. Replace defective joints by cutting out defective joints or replacing fittings. Inspect 100 percent of all joints and reinspect all corrections. Arrange with the pipe manufacturer's representative in the presence of the COR to make first time inspection.

3.2.3 Pressure Tests

Use test pressure of 1 1/2 times maximum working pressure, but in no case less than 50 psig. Do not test until every joint has set and cooled at least 8 hours at temperatures above 50 degrees F. Conduct testing before backfilling; however, place sufficient backfill material between fittings to hold pipe in place during tests. Test system gas tight in accordance with NFPA 54 . Use clean dry air or inert gas, such as nitrogen or carbon dioxide, for testing. Systems which may be contaminated by gas shall first be purged as specified. Make tests on entire system or on sections that can be isolated by valves. After pressurization, isolate entire piping system from sources of air during test period. Maintain test pressure for at least 8 hours between times of first and last reading of pressure and temperature. Take first reading at least one hour after test pressure has been applied. Do not take test readings during rapid weather changes. Provide temperature same as actual trench conditions. There shall be no reduction in the applied test pressure other than that due to a change in ambient temperature. Allow for ambient temperature change in accordance with the relationship PF + 14.7 = (P1 + 14.7) (T2 + 460) / T1 + 460), in which "T" and "PF" represent Fahrenheit temperature and gage pressure, respectively, subscripts "1" and "2" denote initial and final readings, and "PF" is the calculated final pressure. If "PF" exceeds the measured final pressure (final gage reading) by 1/2 psi or more, isolate sections of the piping system, retest each section individually, and apply a solution of warm soapy water to joints of each section for which a reduction in pressure occurs after allowing for ambient temperature change. Repair leaking joints and repeat test until no reduction in pressure occurs. In performing tests, use a test gage calibrated in one psi increments and readable to 1/2 psi.

3.2.4 System Purging

After completing pressure tests, and before testing a gas contaminated line, purge line with nitrogen at junction with main line to remove all air and gas. Clear completed line by attaching a test pilot fixture at capped stub-in line at building location and let gas flow until test pilot ignites. Procedures shall conform to NFPA 54 .

-CAUTION-

Failure to purge may result in explosion within line when air-to-gas is at correct mixture.

-- End of Section --

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WATER METERS

PART 1 GENERAL

1.1 SUMMARY

This section covers installation of water meters (5/8-inch x 3/4-inch, 1-inch, 1-1/2-inch, and 2-inch Displacement Meters; 2-inch, 3-inch, 4-inch, and 6-inch Compound Meters; 2-inch Turbine Meters; 2-inch, 3-inch, 4-inch, and 6-inch Strainers) suitable for billing, allocation of costs, and recording of data for water management and control applications, and provides guidance for the facility energy manager or design engineer after determining what data will be gathered and what analysis procedures will be used.

1.2 DEFINITIONS

Unless otherwise specified or indicated, water terms used in this specification and on the drawings shall be as defined in AWWA C700.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C700	Standard for Cold Water Meters - Displacement Type, Bronze Main Case
AWWA C701	Standard for Cold-Water Meters - Turbine Type for Customer Service
AWWA C702	Cold-Water Meters - Compound Type
AWWA C707	Encoder-Type Remote-Registration Systems for Cold-Water Meters

ASME INTERNATIONAL (ASME)

ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ASME B16.1	Gray Iron Threaded Fittings; Classes 25, 125 and 250

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	National Electrical Safety Code
IEEE C37.90.1	(2002; Errata 2003; Errata 2004) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 61000-4-5	Electromagnetic Compatibility (EMC) - Part 4-5: Testing and Measurement Techniques; Surge Immunity Test; Ed 2.0

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001	Quality Management Systems- Requirements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.18	Protocol Specification for ANSI Type 2 Optical Port
ANSI C62.61	American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

a. Maintenance manual shall provide:

1. Condensed description of how the equipment operates.

2. Block diagram indicating major assemblies.

3. Troubleshooting information.

4. Preventive maintenance.

5. Spare parts information.

b. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data."

SD-02 Shop Drawings

SD-03 Product Data

Protocol modules
Data recorder
Modems

Submittals shall include manufacturer's information for each component, device, and accessory provided with the meters, protocol modules or communications modules.

SD-06 Test Reports

Acceptance checks and tests

SD-10 Operation and Maintenance Data

Water meters
Communications modules
Protocol modules
Data recorder
Modems

1.5 QUALITY ASSURANCE

1.5.1 Installation Drawings

Drawings shall indicate, but not be limited to, the following:

a. Elementary diagrams and wiring diagrams with terminals identified of protocol modules, communications modules Ethernet connections, telephone lines. For each meter installation, provide a diagram identified by the building number.

b. One-line diagram, including meters, protocol modules communications modules, Ethernet connections, telephone outlets, and fuses. For each meter installation, provide a diagram identified by the building number.

1.5.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for five years prior to bid opening. The five-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the five-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section. All meters provided shall be manufactured by a registered ISO 9001 quality standard facility. All specifications shall meet or exceed the latest revision of AWWA C702.

1.5.3 Alternative Qualifications

Products having less than a five-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 10,000 hours, exclusive of the manufacturer's factory or laboratory tests, is provided.

1.5.4 Material and Equipment Manufacturing Data

Products manufactured more than two years prior to date of delivery to the

site shall not be used, unless specified otherwise.

1.6 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract. All meters shall carry the following published warranties:

a. Meters shall be guaranteed to be free from defective materials and workmanship and meet AWWA New Meter Accuracy Standards for a period of five years from the date of installation. At the expiration of this period, meters shall be guaranteed to meet AWWA Repaired Meter Accuracy Standards for the following time periods:

   1. 5/8 inch to 1 inch: 5 to 15 years from the date of shipment.

   2. 1-1/2 inch and larger: 5 to 10 years from the date of shipment.

b. All registers are guaranteed for a ten-year period from the date of purchase. Any defective register will be replaced at no cost to the Government.

c. All brass maincases are guaranteed for life by the manufacturer. Any defective maincase will be replaced at no cost to the Government.

1.7 SYSTEM DESCRIPTION

1.7.1 System Requirements

The metering and reading system, consisting of commercial, off-the-shelf meters, protocol modules and communications modules, and communication channels, will be used to record the water consumption and other values as described in the sections that follow and as shown on the drawings.

1.7.2 Selection Criteria

Metering components are part of a system that includes the physical meter, data recorder function, and communications method. Every building site identified shall include sufficient metering components to measure the water parameters identified and to store and communicate the values as required in the following sections. The Contractor shall verify that the metering system installed on any building site is compatible with the facility-wide communication and meter-reading protocol system.

PART 2 PRODUCTS

2.1 WATER METERS

2.1.1 Physical and Common Requirements

a. Metering system components shall be installed according to the Metering System Schedule shown on the drawings.

b. Meter shall be rated for use at temperatures from -40 degrees Centigrade to +70 degrees Centigrade.

c. Surge withstand shall conform to IEEE C37.90.1.

2.1.1.1 Cold-Water Meters - Displacement Type 5/8-inch x 3/4-inch, 1-inch, 1-1/2-inch, 2-inch Size

Small meters shall be as follows or shall be approved equivalents: Positive displacement meters provided hereunder shall be full-size nutating-disc, magnetic drive, sealed register, cold water meters and shall fully comply with the requirements of AWWA C700 unless otherwise specified hereunder. **No oscillating-piston style meters will be accepted.**

a. Materials

1. Cases 5/8-Inch x 3/4-Inch, 1-Inch, 1-1/2-Inch: The main case of the meter shall be cast all-bronze, bottom caps shall be cast all-bronze, excepting register boxes and register box lids which shall be bronze or an approved plastic material as specified in AWWA C700. Meter cases constructed of plastic will not be accepted.

2. Cases 2-Inch: The main case of the meter shall be cast all-bronze, including bottom caps, excepting register boxes and register box lids which shall be bronze or an approved plastic material. Meter cases constructed of plastic will not be accepted.

3. Register Box Rings and Lids: Register box rings and lids shall be made of a copper alloy containing not less than 57 percent copper, or all bronze, or an approved suitable synthetic polymer.

4. Measuring Chambers: Measuring chambers shall be made of a copper alloy containing not less than 85 percent copper and suitable amounts of tin, lead, and zinc or of a suitable synthetic polymer.

5. Discs: Discs shall be made of vulcanized hard rubber or a suitable synthetic polymer with specific gravity approximately equal to that of water. They shall have sufficient dimensional stability to retain operating clearances at working temperatures of up to +27 degrees Centigrade and not warp or deform when exposed to operating temperatures of +37 degrees Centigrade.

6. Measuring Chamber Diaphragms: Measuring chamber diaphragms shall be made of phosphor bronze, stainless steel, hard rubber, or a suitable synthetic polymer.

7. Spindles, Thrust Rollers, and Thrust-Roller Bearing Plates: Spindles, thrust rollers and thrust-roller bearing plates shall be made of phosphor bronze, stainless steel, hard rubber, or a suitable synthetic polymer.

8. Intermediate Gear Trains: Frames, gears, and pinions shall be made of a suitable copper alloy, other suitable non-corrosive metals, or other suitable materials.

9. External Fasteners (Casing Bolts, Studs, Nuts, Screws, and Washers): External fasteners shall be made of a copper alloy containing not less than 57 percent copper, stainless steel, or steel treated to resist corrosion by a process approved by the Government. Fasteners for no-pressure assemblies may be made of a suitable synthetic polymer. All external case closures, such as rings, clamps, screws, bolts, cap bolts, nuts and washers, shall be designed for easy removal following lengthy service.

10. Water Meter Coupling - 5/8-Inch x 3/4-Inch: A water coupling shall be composed of one meter coupling nut, one meter coupling tail piece (straight), and one rubber-type washer for meter coupling. The meter coupling tailpiece and nut shall be a copper alloy containing not less than 57 percent copper. The coupling nut shall have internal straight pipe threads conforming to ASME B1.20.1. Pitch diameter shall be that shown on AWWA C700. The coupling tailpiece shall have external taper pipe threads conforming to ASME B1.20.1 and an internal diameter approximately equal to the nominal thread size of the tailpiece. Lengths and thread sizes shall be those listed in AWWA C700. One water meter coupling and one additional rubber-type washer for meter coupling (total of two rubber-type washers) shall be provided with each meter.

11. Companion Flanges - 1-1/2-Inch and 2-Inch: Companion flanges shall be made of cast iron.

b. General Design

1. Pressure Requirements: Meters supplied under this specification shall operate without leakage or damage to any part at a working pressure of 150 psi.

2. Accessibility: All 1-1/2-inch and 2-inch meters shall be designed for easy removal of all interior parts without disturbing the connections to the pipeline.

c. Detail Design

1. Cases: All meters shall have an outer case with separate, removable measuring chambers. Cases shall not be repaired in any manner. The inlet and outlet shall have a common axis. A meter case shall include the top case and bottom case, or main case and bottom plate, whichever is applicable. Connection flanges shall be parallel.

2. Connections: Meter case connections for 5/8-inch x 3/4-inch and 1-inch meters shall be meter casing spuds on both ends. Spuds shall have external straight threads conforming to ASME B1.20.1 as far as the specifications apply. Pitch diameters shall be those shown in AWWA C700. Main case connections for 1-1/2-inch and 2-inch meters shall be oval-flanged on both ends. Flanges shall be faced and drilled and shall be the oval type. The drilling shall be on a horizontal axis; the number of bolt holes and the diameters of the bolt holes and bolt circle shall be as listed in AWWA C700. Two oval companion flanges, gaskets, bolts and nuts shall be provided with each meter. Companion flanges shall be faced, drilled, and tapped in conformance with ASME B1.20.1. Dimensions shall be those listed in AWWA C700. Companion flanges shall be cast iron.

3. Registers: Registers shall be straight-reading and shall read in 1000-gallon increments. The register shall be equipped with a center-sweep test hand with the test circle located on the periphery of the register and graduated in 100 equal parts, with each tenth graduation being numbered. Register construction shall conform to all applicable requirements of AWWA C700.

4. Register Boxes: The lid shall be recessed and shall overlap the register box in order to protect the lens. The lens shall be held securely in place.

5. Intermediate Gear Trains: Intermediate gear trains may be mounted on the measuring chamber, in the upper main casing, or when not exposed to water, combined with or adjacent to the register gearing.

   (a) Oil-enclosed type - Gear trains exposed to water shall be of the oil-enclosed type, shall have a separate housing or form housing with the main casing or measuring chamber, and shall operate in a suitable lubricant.

   (b) Magnetic coupled drives - When intermediate gear trains are located in the water compartment of the meter, the revolutions of the train output spindles shall be transmitted to the registers by means of magnetic couplings through the meter cases. When the intermediate gear trains are located in the register compartments, the disc nutations shall be transmitted by magnetic couplings.

6. Measuring Chambers: The measuring chambers shall be self-contained units, smoothly finished, firmly seated, and easily removed from the main cases, and shall not be cast as part of the main cases. The measuring chambers shall be so secured in the main cases that the accuracy of the meter will not be affected by any distortion of the cases that might occur when operating with a pressure less than 150 psi.

7. Discs: Discs shall be smoothly finished, disc plated, whether flat or conical, shall be either reinforced or equipped with thrust rollers. Discs may be one piece or composed of a plate with two half balls. The disc spindles shall be fastened securely. The disc nutations shall not exceed the quantities listed in AWWA C700.

8. Strainers: All meters shall be provided with strainer screens installed in the meter. Strainer screens shall be rigid, fit snugly, be easy to remove, and have an effective straining area at least double that of the main case inlet.

9. Seal Wire Holes: Register box screws and inlet and outlet coupling nuts, if provided, shall be drilled for seal wires. Seal wire holes shall not be less than 3/32 inch in diameter.

10. Registration Accuracy: Meters shall meet the following requirements for accuracy with water of a temperature of less than +27 degrees Centigrade.

    (a) Normal Flow Limits - At any rate of flow within the normal test flow limits specified on AWWA C700, the meter shall not register less than 98.5 percent and not more than 101.5 percent of the water that actually passes through it.

    (b) Minimum Test Flow - At the minimum test flow rate specified in AWWA C700, the meter shall not register less than 95 percent and not more than 101 percent of the water that actually passes through it.

11. Markings: The size, model, and direction of flow through the meter

shall be marked permanently on the outer case of all meters. All meters shall have the manufacturer's serial numbers stamped on the meter main case and top of the reading lid.

12. Register Boxes: The name of the manufacturer shall be marked permanently on the lid of the register box. The serial number of the meter shall be imprinted on the lid and the main case.

2.1.1.2 Cold-Water Meters - Compound Type 2-Inch, 3-Inch, 4-Inch, and 6-Inch Size

Compound meters shall consist of a combination of a main-line meter of the turbine type for measuring high rates of flow and a meter of appropriate size for measuring low rates of flow. The compound meter shall have an automatic valve mechanism for diverting low rates of flow through the bypass meter. **Both metering devices with registers shall be contained in the same case.** The operating and physical characteristics shall conform to those specified within AWWA C702.

a. Materials

1. Cases: The main case of the meter shall be made of a copper alloy containing not less than 75 percent copper.

2. Register Box Rings and Lids: Register box rings and lids shall be made of a cast copper alloy containing not less than 75 percent copper, forged or die-cast copper alloy containing not less than 57 percent copper or a suitable synthetic polymer.

3. Measuring Cages or Chambers: Measuring cages or chambers shall be made of a copper alloy containing not less than 84 percent copper and suitable amounts of tin, lead, and zinc or of a suitable synthetic polymer.

4. Measuring Turbines, Pistons and Discs: Turbines, pistons and discs shall be made of vulcanized hard rubber or a suitable synthetic polymer with specific gravity approximately equal to that of water. They shall have sufficient dimensional stability to retain operating clearances at working temperatures of up to +27 degrees Centigrade and not warp or deform when exposed to operating temperatures of +37 degrees Centigrade.

5. Disc and Turbine Spindles: Measuring chamber spindles shall be made of phosphor bronze, stainless steel, ceramic, or suitable synthetic polymer.

6. Intermediate Gear Trains: Frames, gears and pinions of intermediate gear trains exposed to water shall be made of copper alloy containing not less than 85 percent copper and suitable amounts of tin, lead, and zinc, or suitable synthetic polymer. When not exposed to water, intermediate gear trains may be made of a suitable synthetic polymer.

7. External Fasteners (Casing Bolts, Studs, Nuts, Screws, and Washers): External fasteners shall be made of a copper alloy containing not less than 57 percent copper, stainless steel, or steel treated to resist corrosion by a process approved by the Government. Fasteners for no-pressure assemblies may be made of a suitable synthetic polymer. All external case closures, such as

rings, clamps, screws, bolts, cap bolts, nuts and washers, shall be designed for easy removal following lengthy service.

8. Companion Flanges: Companion flanges shall be made of cast iron.

9. Automatic Valves: The valve weights shall be lead, or a copper alloy containing not less than 75 percent copper, or a copper alloy shell loaded with lead. The valve and supplemental hinge pins or spindles shall be a copper alloy containing not less than 75 percent copper, or stainless steel, and all valve and supplemental weight hinge bearings shall be bushed with hard rubber or bronze or other suitable bushing material. If the valve contains a clapper, it shall be faced with a removable semi-hard seat. Valve seats shall be made of a copper alloy containing not less than 75 percent copper and suitable amounts of tin, lead, and zinc.

b. General Design

1. Pressure Requirements: Meters supplied under this specification shall operate without leakage or damage to any part at a working pressure of 150 psi.

2. Accessibility: All compound meters shall be designed for easy removal of all interior parts without disturbing the connections to the pipeline.

3. Registration Accuracy: Meters shall meet the following requirements for accuracy with water of a temperature of less than +27 degrees Centigrade.

(a) Normal Flow Limits - The meter shall not register less than 97 percent and not more than 103 percent of the water actually passed through it at any rate of flow within the normal test flow limits specified in AWWA C702, except in the registration of flows within the changeover from bypass meter to main meter.

(b) Changeover Flow - The beginning of the changeover is when the accuracy of registration falls below 97 percent due to the operation of the automatic valve mechanism, and the end of changeover is when accuracy of registration again reaches 97 percent. The registration of these changeover rates of flow shall not be less than 90 percent and not more than 103 percent. The difference in the rate of flow at the beginning and at the end of the changeover shall not exceed the figures listed in AWWA C702.

(c) Minimum Test Flow - There shall not be less than 95 percent of actual flow recorded when a test is made at the minimum test flow shown in AWWA C702.

4. Markings: The size, model, and direction of flow through the meter shall be cast or stamped in the outer case of all meters.

(a) Register Boxes - The name of the manufacturer shall be permanently impressed on the lid of the register box. The serial number of the meter shall be imprinted on the lid.

c. Detail Design

1. Main Case: All meters shall have an outer case with separate, removable measuring chambers. Cases shall not be repaired in any manner. The inlet and outlet shall have a common axis. Connection flanges shall be parallel.

2. External Case Screw, Bolts, Nuts and Washers: All external screws, bolts, cap bolts, nuts and washers shall be designed for easy removal after lengthy service.

3. Main Case Connections: All main case connections shall be flanged. The bolt holes shall comply with AWWA C702.

   (a) 2-Inch Meters - The flanges for 2-inch meters shall be oval. The drilling of oval flanges shall be on the horizontal axis.

   (b) Meters Larger than 2-Inch - The flanges for 3-inch, 4-inch, and 6-inch meters shall be the round type, faced and drilled, and shall conform to ASME B16.1 for bronze pipe flange, Class 125.

4. Companion Flanges: Companion flanges of the same size and type as the meter flanges shall be provided, and gaskets, nuts, and bolts shall be provided. Round companion flanges shall be faced, drilled, and tapped in accordance with ASME B1.20.1 and shall conform to ASME B16.1 for cast-iron pipe flange, Class 125. All companion flanges shall comply with AWWA C702 for drilling, diameter, and thickness specifications.

5. Tapped Bosses: All meters shall be provided with tapped bosses in the top of the case near the outlet for field testing purposes.

6. Registers: Registers shall be straight reading and shall read in cubic feet (cu.ft.). Except for those instances when test conditions require the use of a different register, the register provided with the meter shall be the same register that was on the meter when it was tested for accuracy. The register lock and side gears shall be fastened securely to the number wheel discs and hubs. The tumbler pins shall mesh accurately at the turnover points with the lock and side gears of the adjacent number wheels. Both main and pinion shafts shall be so secured in the register frame and/or register plates that they cannot get out of position. The pinion shaft shall be so designed that there is no possibility of its bending and allowing the pinion to skip the turnover point. The numerals on the number wheels shall not be less than 3/16 inch in height and should be readable at a 45-degree angle from vertical. Registers that are hermetically sealed shall have gears and pinion which shall run free on fixed shafts or be fixed on shafts that run free in the register frame and/or register plates and shall be constructed so that they cannot be unmeshed. The registers shall have a center-sweep test hand with a test circle located on the periphery of the register and graduated in 100 equal parts, each tenth graduation numbered. The maximum quantity indicated by a single revolution of the test hand and the minimum capacity of the register shall be as listed in AWWA C702. The maximum indication on the test circle and the minimum register capacity of the bypass unit shall be in accordance with the approved AWWA Standard for the type of meter used as the bypass unit.

   (a) Coordinator Registers - The meter may be equipped with a

coordinator so that the readings of both sections can record on a single register. The register construction shall conform to previously mentioned requirements, and the maximum quantity indicated by a single revolution of the test hand and the minimum capacity of the register shall conform to AWWA C702.

7. Register Boxes: The lid shall be recessed and shall overlap the register box to protect the lens.

8. Intermediate Gear Trains: Intermediate gear trains may be mounted on the measuring chamber or cage or in the main casings. When not exposed to water, they may also be combined with or adjacent to the register gearing. Gear trains exposed to water shall be the oil-enclosed type, shall have separate housings or shall form housings with the main casings or measuring chambers, and shall operate in a suitable lubricant. Gear trains made of non-corrosive metals or synthetic polymers may be exposed to water.

9. Measuring Chambers or Cages: The main-line section chambers or cages shall be self-contained units firmly seated and easily detached and removed from the main case. Chambers or cages with turbines that have revolving spindles shall have removable bearings for such spindles. Chambers or cages with stationary spindles on which the turbines revolve shall provide rigid, centrally located fastenings for the spindles. The spindles shall be removable. The main-line section chambers or cages shall be interchangeable in all meters of the same size, make, and model.

   (a) Bypass Chamber - The bypass chamber shall be a type covered by an approved AWWA Standard. The chamber shall be a self-contained unit, firmly seated and easily removed from the case, and shall not be cast as part of the outer case. The chamber shall be secured in position in the outer case so that any slight distortion of the case which might occur under 150 psi pressure will not affect the accuracy of the meter.

10. Measuring Turbines and Discs: Measuring turbines that have revolving spindles shall rotate on spindles supported by bushings or replaceable bearings. Turbines that rotate on stationary spindles shall also have bushings or replaceable bearings. The plates of disc pistons, whether flat or conical, shall have metal reinforcements or shall be equipped with thrust rollers.

11. Magnetic Coupled Drives: When intermediate gear trains are located in the water compartment of the main or bypass section of the meter, the revolutions of the train output spindles shall be transmitted to the registers by means of magnetic couplings through the meter case. When intermediate gear trains are located in the register compartments, the revolutions shall be transmitted by magnetic coupling.

12. Automatic Valves: The automatic valve shall be of a type suitable for such purpose. It shall close by force. The weight of the valve and any supplemental force imposed on it shall offer sufficient resistance to the incoming water to divert all small rates of flow through the bypass meter until such time as the rate of flow through the meter is great enough to ensure efficient operation of the main measuring section. Valve hinge pins or spindles shall be bushed. Valve sets shall be bronze or other corrosion-resistant

material, shall have a satisfactory width of face, and shall be held firmly in place. A clapper or swing-type valve shall be provided with a removable semi-hard seat.

13. Bypass Meter: The physical and operating characteristics and dimensions of the bypass meter shall be in accordance with the approved AWWA Standard for the type of meter used as the bypass.

14. Strainers: Strainers, if provided, shall be rigid, shall be easily removed and shall have an effective straining area at least double that of the water main-case inlet.

15. Seal Wire Holes: Register box screws shall be drilled for seal wires. Seal wire holes shall be not less than 3/32 inch in diameter.

2.1.1.3 Cold-Water Meter - Turbine Type 2-Inch Size

Turbine meters provided hereunder shall be Class II, in-line, horizontal-axis, high-velocity type and shall fully conform to the requirements of AWWA C701, except as otherwise specified herein. The 2-inch turbine meter shall have oval flanged ends and shall be supplied with one companion flange, gaskets, and with bolts and nuts as specified herein.

a. Materials

1. Cases: All turbine main cases shall be bronze. No exceptions will be allowed.

2. Register Box Rings and Lids: Register box rings and lids shall be made of a cast copper alloy containing not less than 75 percent copper, forged or die-cast copper alloy containing not less than 57 percent copper or a suitable synthetic polymer.

3. Measuring Cages or Chambers: Measuring cages or chambers shall be made of a copper alloy containing not less than 84 percent copper and suitable amounts of tin, lead, and zinc or of a suitable synthetic polymer.

4. Measuring Turbines, Pistons and Discs: Turbines, pistons and discs shall be made of vulcanized hard rubber or a suitable synthetic polymer with specific gravity approximately equal to that of water. They shall have sufficient dimensional stability to retain operating clearances at working temperatures of up to +27 degrees Centigrade and not warp or deform when exposed to operating temperatures of +37 degrees Centigrade.

5. Disc and Turbine Spindles: Measuring chamber spindles shall be made of phosphor bronze, stainless steel, ceramic, or suitable synthetic polymer.

6. Intermediate Gear Trains: Frames, gears and pinions of intermediate gear trains exposed to water shall be made of copper alloy containing not less than 85 percent copper and suitable amounts of tin, lead, and zinc, or suitable synthetic polymer. When not exposed to water, intermediate gear trains may be made of a suitable synthetic polymer.

7. External Fasteners: (casing bolts, studs, nuts, screws, and

washers). External fasteners shall be made of a copper alloy containing not less than 57 percent copper, stainless steel, or steel treated to resist corrosion by a process to be approved by the Government. Fasteners for no-pressure assemblies may be made of a suitable synthetic polymer. All external case closures, such as rings, clamps, screws, bolts, cap bolts, nuts and washers, shall be designed for easy removal following lengthy service.

8. Companion Flanges: Companion flanges shall be made of cast iron.

b. General Design

1. Pressure Requirements: Meters supplied under this specification shall operate without leakage or damage to any part at a working pressure of 150 psi. Pressure drop through turbine meters and strainers, when operated within specified normal flow limits, shall not exceed the characteristics outlined in AWWA C701.

2. Accessibility: All turbine meters shall be designed for easy removal of all interior parts without disturbing the connections to the pipeline. Turbine meters shall have readily accessible change gears, adjustable vanes or other approved means to adjust meter registration. Such adjustment feature shall be an integral part of the removable rotor/register assembly and not of the main or bottom case of the meter.

3. Registration Accuracy: Meters shall meet the following requirements for accuracy with water of a temperature of less than +27 degrees Centigrade.

(a) Normal Flow Limits - The meter shall not register less than 97 percent and not more than 103 percent of the water actually passed through it at any rate of flow within the normal test flow limits specified in AWWA C702, except in the registration of flows within the changeover from bypass meter to main meter. Turbine meters shall be designed to allow prolonged operation at or near the upper limit of the specified normal flow range without premature degradation of registration accuracy or other evidence of undue wear. Meters shall also be capable of accepting sudden increases in flow at high rates of flow without decoupling the register.

2.1.1.4 Cold-Water Meter Strainers 2-Inch, 3-Inch, 4-Inch and 6-Inch Size

General: All strainers provided shall have top access. Cases for 2-inch, 3-inch, 4-inch and 6-inch strainers shall be bronze. Strainer plates for all sizes shall be 18-8 stainless steel or bronze. All strainers shall conform to AWWA C702.

NOTE: SeBiLOY is an acceptable substitute for bronze.

2.1.2 Meter Programming

a. Meter shall be programmable by software supplied by the meter manufacturer.

b. Software shall have a user-friendly, Windows-compatible interface.

c. Software shall operate on Windows, operating systems.

d. Software shall allow the user to configure the meter, troubleshoot the meter, query and display meter parameters and configuration data and stored values.

e. Meter firmware shall be upgradeable through one of the communications ports without removing the unit from service.

f. Meter shall include output options for analog milliamp signals.

g. Meter shall have two channels of analog output, 0-1mA or 4-20mA, for positive watt/hour readings.

h. Meter shall have two form C, dry contact relay outputs for alarm or control.

2.1.3 Register Requirements for Remote Registration

a. Meters must have encoder-type remote-registration conforming to the latest version of AWWA C707. Registers using generator pulses or low voltage conversions are not permitted. Power requirement for data transmission must be supplied by an interrogation device. Registers must be compatible with various brands of interrogation equipment. The register must provide at least six-digit visual registration at the meter. The units, the month and year of manufacture, and other identification information must clearly be printed on the face of the register. The register must also have a full test sweep hand or dial. The register must, in a digital format, simultaneously encode at least six significant digits of the meter reading for transmission through the remotely located receptacle. A meter identification number must also be provided with each reading.

b. All registers shall be easily upgraded to Automatic Meter Reading (AMR), which includes telephone, radio, cable, Energy Management and Control System (EMCS), Direct Digital Control (DDC), and Supervisory, Control and Data Acquisition (SCADA), with the substitution of the remote receptacle with a Meter Interface Unit (MIU). Data transmission shall be instantaneous and supplied in ASCII format without conversion or modification. The register must operate reliably down to at least 3.0 volts. Color-coded wire terminals (red, green and black) shall be provided; however, only the red and black terminals will be utilized for a two-wire connection to the interface ScanPad. The green terminal shall only be utilized to convert to AMR via the use of a MIU. A suitable wire terminal cover shall be provided and be factory potted when ordered for underground pit installations.

c. All registers must be removable without disassembly of the meter or depressurizing the service line. The register must be free of openings to protect the internal electronics of the register. Lens covers shall be made of polycarbonate or other suitable engineering polymer for indoor installations and mineral glass for underground pit installations. All other register assembly and material requirements stated herein shall also apply.

2.2 COMMUNICATIONS

2.2.1 Communications Methods

a. Optical Port

The optical port shall communicate with a hand-held reading device according to the following requirements.

1. Communications standards

   (a) ANSI C12.18

   (b) MV90 protocol

2. Read operations

   (a) Current values

   (b) Values since last reset

   (c) Last reset value

   (d) Meter status

3. Write operations

   (a) Meter setup

b. Serial Port

Provide a serial port for connection to the modem module where required in this specification.

1. On-board serial port types

   (a) RS232

c. Ethernet

For those meters using the Ethernet, logged information shall be sent using open standard Internet protocols.

1. On-board Ethernet port support

   (a) HTTP

   (b) SMTP

   (c) Modbus

2. Distribute stored data by:

   (a) FTP

3. On-board web server

2.2.2 Communications Protocols and Methods

Communications protocols and methods shall be native to the meter. Provide communications modules as required to accomplish the following.

a. Meter shall include an IR port ("IR" in Metering Systems Schedule) (for communication to external devices such as handheld readers) that

supports a minimum speed of 9600 baud.

b. Meter shall include one RS-232 or oneRS-485 digital communication port. Each port shall be user-configurable with regard to speed, protocol, address, and other communications parameters. Ports shall support a minimum communication speed of 9600 baud for the RS232 port.

c. Meter shall have a port that can be configured as a 10/100 Base-T Ethernet port.

   1. A communication module that converts serial RS232 or RS485 to Ethernet will be acceptable.

d. Auto Answer minimum 1200 baud internal modem . Internal modems shall include automatic data buffering to provide faster, more reliable communications and the ability to automatically answer on a connected line.

e. Meter shall be equipped with one pulse output channel that can be configured for operation as KYZ pulse output.

2.2.3 Communications Channels Surge Protection

Communications equipment shall be protected against surges induced on its communications channels. Communication interfaces to all field equipment shall be protected to meet the requirements of IEEE C37.90.1 or the requirements of IEC 61000-4-5, test level 4, while the equipment is operating. Fuses shall not be used for surge protection. Metallic cables and conductors which serve as communications channels between buildings shall have surge protection installed at equipment rated for the application installed at each end, within three feet of the building cable entrance. Surge protectors shall meet the requirements of the applicable extension of ANSI C62 (for example, ANSI C62.61).

2.3 METER DATA PROTOCOL

Power meters shall have communicating data protocols native or provided in supplemental modules to communicate with the communications methods that follow.

2.3.1 Open Protocol

The Contractor shall verify that the meter native protocol is consistent with the facility data recording and communication and data storage system. The Contractor shall provide additional converters and modules as required for a complete measurement, recording, communicating and data storage system.

a. Meter shall be fully supported by MV-90 software system or existing AMR software that is MV-90 compatible.

b. For systems that use proprietary software, an alternative, competitive software system must be available.

Systems capable of using more than one brand of commercially available meters are expected. In addition, if proprietary meter reading software is used, meters are to be capable of being read by more than one manufacturer's software.

2.4 SPARE PARTS

2.4.1 Parts List

Provide spare parts as follows:

a. Water meters - one for every 20 installed.

b. Communications modules - one for every 20 used.

c. Protocol modules - one for every 20 used.

d. Other electronic and power components - one for each type used.

2.5 METERING SYSTEM SCHEDULE

METERING SYSTEM SCHEDULE				
1	2	3	4	5
Bldg #	Type of Meter	Communication	Meter Location	Remarks
101	1" displacement	IR RS232	Bldg	Small building. Consumption reimbursable billing only.
102	2" turbine	BaseT, 56K	Bldg	Interval recording
103	3/4" displacement	Local	Bldg	

Metering System Schedule Notes by column position:

PART 3 EXECUTION

3.1 INSTALLATION

Water meter installations shall conform to AWWA C700, AWWA C701 and AWWA C702. Electrical installations shall conform to IEEE C2, NFPA 70 (National Electrical Code), and to the requirements specified herein. Provide new equipment and materials unless otherwise indicated or specified.

3.1.1 Existing Condition Survey

The Contractor shall perform a field survey, including inspection of all existing equipment, resulting clearances, and new equipment locations intended to be incorporated into the system, and provide an existing conditions report to the Government. The report shall identify those items that are non-workable as defined in the contract documents. The Contractor shall be held responsible for repairs or modifications necessary to make the system perform as required.

3.1.2 Scheduling of Work and Outages

The Contract clauses shall govern regarding permission for water/power outages, scheduling of work, coordination with Government personnel, and

special working conditions.

3.2 FIELD-APPLIED PAINTING

Where field painting of enclosures is required to correct damage to the manufacturer's factory-applied coatings, provide the manufacturer's recommended coatings and apply in accordance with the manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

3.3.1 Performance of Acceptance Checks and Tests

a. Meter Assembly

1. Visual and mechanical inspection

(a) Compare equipment nameplate data with specification and approved shop drawings.

(b) Inspect physical and mechanical condition.

(c) Verify grounding of metering enclosure, if required.

(d) Verify the presence of surge arresters.

2. Electrical tests

(a) Verify that correct multiplier has been placed on face or meter, where applicable.

(b) Prior to system acceptance, the Contractor will demonstrate and confirm the meter is properly wired and is displaying correct and accurate water information.

3.3.2 Follow-up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the Contract, the COR shall be given five working days' advance notice of the dates and times of checking and testing.

3.3.3 Training

The Contractor shall conduct a training course for meter configuration, operation, and maintenance of the system as specified. The training shall be oriented for all components and systems installed under this Contract. Training manuals shall be delivered for 4 trainees with two additional copies delivered for archiving at the project site. The Contractor shall provide all audiovisual equipment and all other training materials and supplies. A training day is defined as eight hours of classroom instruction, including two 15-minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility. For guidance in planning the required instruction, the Contractor shall assume that attendees have a high school education or equivalent, and are familiar with utility systems. Approval of the planned training schedule shall be obtained from the Government at least 30 days prior to the training.

a. Training

The course shall be taught at the project site within 30 days after completion of the installation for a period of one day. A maximum of 6 personnel will attend the course. The training shall include:

1. Physical layout of each piece of hardware.

2. Meter configuration, troubleshooting and diagnostics procedures.

3. Repair instructions.

4. Preventive maintenance procedures and schedules.

5. Testing and calibration procedures.

-- End of Section --

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SECTION 33 30 00

SANITARY SEWERS

PART 1 GENERAL

1.1 SUMMARY

This section covers piping and appurtenant structures for an exterior sanitary sewer system.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-102	Concrete Pipe Handbook
ACPA 01-103	Concrete Pipe Installation Manual

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	Grooved and Shouldered Joints
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
AWWA M23	Manual: PVC Pipe - Design and Installation

ASTM INTERNATIONAL (ASTM)

ASTM D 2235	Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2412	Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 2680	Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and

	Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3350	Polyethylene Plastics Pipe and Fittings Materials
ASTM D 412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 624	Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM F 402	Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 894	Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

1.3 SYSTEM DESCRIPTION

1.3.1 Sanitary Sewer Gravity Pipeline

Provide mains and laterals of clay pipe, acrylonitrile-butadiene-styrene (ABS) composite plastic pipe or polyvinyl chloride (PVC) plastic pipe. Provide building connections of acrylonitrile-butadiene-styrene (ABS) solid-wall plastic pipe or polyvinyl chloride (PVC) plastic pipeas indicated on the Drawings and directed by utility authorities.

1.3.2 Sanitary Sewer Pressure Lines

Provide pressure lines as indicated on the Drawings and directed by the utility authorities.

1.3.3 USACENASA Project

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. Replace damaged material and redo unacceptable work at no additional cost to the Government. Backfilling shall be accomplished after inspection by the COR. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the COR. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions

SD-02 Shop Drawings

Drawings
Precast concrete manhole
Metal items
Frames, covers, and gratings

SD-03 Product Data

Pipeline materials

SD-06 Test Reports

Reports

SD-07 Certificates

Portland Cement
Gaskets

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualifications

Install specified materials by a licensed underground utility Contractor licensed for such work in California where the work is to be performed. Installing Contractor's License shall be current and be state certified or

state registered.

1.5.2 Drawings

a. Submit Installation Drawings showing complete detail, both plan and side view details with proper layout and elevations.

b. Submit As-Built Drawings for the complete sanitary sewer system showing complete detail with all dimensions, both above and below grade, including invert elevation.

c. Sign and seal As-Built Drawings by a Professional Surveyor and Mapper. Include the following statement: "All potable water lines crossed by sanitary hazard mains are in accordance with the permitted utility separation requirements."

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery and Storage

1.6.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.6.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.6.1.3 Cement, Aggregate, and Reinforcement

As specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

1.6.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.

1.7 PROJECT/SITE CONDITIONS

Submit drawings of existing conditions, after a thorough inspection of the area in the presence of the COR. Details shall include the environmental conditions of the site and adjacent areas. Submit copies of the records for verification before starting work.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below. Submit manufacturer's standard drawings or catalog cuts.

When a conflict occurs conform to local sanitary district pipe material specifications and requirements.

2.1.1 Cast-Iron Soil Piping

2.1.1.1 Cast-Iron Hub and Spigot Soil Pipe and Fittings

ASTM A74, extra heavy, with ASTM C564 compression-type rubber gaskets.

2.1.1.2 Soil Pipe and Fittings

Cast-Iron Hubless Soil Pipe and Fittings CISPI 301 with CISPI 310 coupling joints

2.1.2 Clay Piping

2.1.2.1 Clay Pipe and Fittings

ASTM C700, extra strength bell-and-spigot piping only.

2.1.2.2 Clay Piping Jointing Materials

ASTM C425.

2.1.3 Concrete Gravity Sewer Piping

2.1.3.1 Concrete Gravity Pipe and Fittings Pipe shall be reinforced concrete pipe conforming to ASTM C76

Circular pipe with elliptical reinforcement shall have a readily visible line at least 12 inches long painted or otherwise applied on the inside and outside of the pipe at each end so that when the pipe is laid in the proper position, the line will be at the center of the top of the pipe. Fittings and specials shall conform to the applicable requirements specified for the pipe and shall be of the same strength as the pipe. Cement used in manufacturing pipe and fittings shall be Type V conforming to ASTM C150/C150M.

2.1.3.2 Jointing Materials for Concrete Gravity Piping

Gaskets and pipe ends for rubber gasket joint shall conform to ASTM C443. Gaskets shall be suitable for use with sewage. Submit certificates of compliance stating that the fittings or gaskets used for waste drains or lines designated on the plans.

2.1.4 Concrete Pressure Piping

2.1.4.1 Concrete Pressure Pipe and Fittings

Pipe shall conform to ASTM C361. Pipe shall be designed for hydrostatic head of 100 feet and external loading of 20 feet of earth cover. Circular pipe with elliptical reinforcement shall have a readily visible line at least 12 inches long painted or otherwise applied on the inside and outside of the pipe at each end so that SECTION 33 when the pipe is laid in the proper position, the line will be at the center of the top of the pipe. Cement used in manufacturing pipe and fittings shall be Type V. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used.

Sleeve-type mechanical couplings shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint.

Grooved and Shouldered Type Joints: Grooved pipe ends Shouldered pipe ends and couplings shall conform to AWWA C606. Joint dimensions shall be as specified in AWWA C606 for rigid joints.

2.1.5 ABS Composite Plastic Piping

2.1.5.1 ABS Composite Plastic Pipe and Fittings

ASTM D 2680.

2.1.5.2 Jointing Materials for ABS Composite Plastic Piping

Solvent cement and primer shall conform to ASTM D 2680.

2.1.6 ABS Solid-Wall Plastic Piping

2.1.6.1 ABS Solid-Wall Plastic Pipe and Fittings

ASTM D 2751, SDR 35, with ends suitable for either solvent cement joints or elastomer joints.

2.1.6.2 ABS Solid-Wall Plastic Joints and Jointing Materials

Solvent cement for solvent cement joints shall conform to ASTM D 2235. Elastomeric joints shall conform to ASTM D 3212. Gaskets for elastomeric joints shall conform to ASTM F 477.

2.1.7 PVC Plastic Gravity Sewer Piping

ASTM D 3034, SDR 35, or ASTM F 949 with ends suitable for elastomeric gasket joints.

2.1.7.1 PVC Plastic Gravity Pipe and Fittings

ASTM D 3034, SDR 35, or ASTM F 949 with ends suitable for elastomeric gasket joints.

a. Pipe and Fittings 4 inch Diameter to 12 inch: Pipe shall conform to AWWA C900 and shall be plain end or gasket bell end, Pressure Class 150 (DR 18), with cast-iron-pipe-equivalent OD. Fittings shall be gray-iron or ductile-iron conforming to AWWA C110/A21.10 or AWWA C153/A21.53 and shall have cement-mortar lining conforming to AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with the PVC plastic pressure pipe specified in this paragraph.

2.1.7.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.1.8 High Density Polyethylene Pipe

ASTM F 894, Class 63, size 18 inch through 120 inch. ASTM F 714, size 4

inch through 48 inch. The polyethylene shall be certified by the resin producer as meeting the requirements of ASTM D 3350, cell Class 334433C. The pipe stiffness shall be greater than or equal to 1170/D for cohesionless material pipe trench backfills. Fittings for High Density Polyethylene Pipe: ASTM F 894. Joints for high density polyethylene pipe: Rubber gasket joints shall conform to ASTM C443.

2.1.9 Reinforced Plastic Mortar Pipe (RPMP)

Reinforced plastic mortar pipe shall be produced be in accordance with ASTM D 3262 and shall have an outside diameter equal to ductile iron pipe dimensions from 18 inches to 48 inches. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner. The minimum pipe stiffness shall be 36 psi. RPMP shall be in accordance with ASTM D 3262. Fittings for RPMP: ASTM D 3840. Joints for RPMP: Bell and spigot gasket coupling utilizing an elastomeric gasket in accordance with ASTM D 4161 and ASTM F 477.

2.1.10 Reinforced Thermosetting Resin Pipe (RTRP)

RTRP pipe: ASTM D 3262. Fittings for RTRP: ASTM D 3262. Joints for RTRP: Bell and spigot type utilizing an elastomeric gasket in accordance with ASTM F 477.

2.1.10.1 Filament Wound RTRP-I

RTRP-I shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 150 psi at 73 degrees F. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996.

2.1.10.2 Centrifugally Cast RTRP-II

RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

2.2 CONCRETE MATERIALS
2.2.1
2.2.1 Portland Cement

Submit certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes. Portland cement shall conform to ASTM C 150, Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking.

2.2.2 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 2500 psi minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Precast Concrete Manholes & Glass-Fiber-Reinforced Polyester Manholes

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C478 and base and first riser shall be monolithic. Glass-Fiber-Reinforced Polyester Manholes shall conform to ASTM D 3753.

2.3.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C923 or ASTM C990.

2.3.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Propylene Diene Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals

Physical Properties Test Methods EPDM Neoprene Butyl mastic

Tensile, psi ASTM D 412 1840 2195 - Elongation percent ASTM D 412 553 295 350

Tear Resistance, ppi ASTM D 624 280 160 - (Die B)

Rebound, percent, ASTM C972 - - 11 5 minutes (mod.)

Rebound, percent, ASTM C972 - - 12 2 hours

2.3.4 Metal Items

2.3.4.1 Frames, Covers, and Gratings

Frames, Covers, and Gratings for Manholes CID A-A-60005, cast iron; figure numbers shall be as follows:

a. Traffic manhole: Provide in paved areas.
   Frame: Figure 1, Size 22A
   Cover: Figure 8, Size 22A
   Steps: Figure 19

b. Non-traffic manhole:
   Frame: Figure 4, Size 22

Cover: Figure 12, Size 22
Steps: Figure 19

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds. Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM C478. The word "Sanitary Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.4.2 Manhole Steps

Zinc-coated steel conforming to 29 CFR 1910.27. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Rubber shall conform to ASTM C443, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 4 feet deep.

2.3.4.3 Manhole Ladders

A steel ladder shall be provided where the depth of a manhole exceeds 12 feet. The ladder shall not be less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A123.

2.4 REPORTS

Submit Test Reports. Compaction and density test shall be in accordance with Section 31 00 00 EARTHWORK. Submit Inspection Reports for daily activities during the installation of the sanitary system. Information in the report shall be detailed enough to describe location of work and amount of pipe laid in place, measured in linear feet.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."or when they conflict with local sanitary district installation requirements.

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 5 feet from the building , unless otherwise indicated.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for

lowering sections of pipe into trenches. Lay nonpressure pipe with the bell or groove ends in the upgrade direction. Adjust spigots in bells and tongues in grooves to give a uniform space all around. Blocking or wedging between bells and spigots or tongues and grooves will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose. Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

3.1.1.4 Connections to Existing Lines

Obtain approval from the local sanitary district and COR before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.1.2 Special Requirements

3.1.2.1 Installation of Cast Iron Soil Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the pipe manufacturer. Make joints with the rubber gaskets specified for cast iron soil pipe joints and assemble in accordance with the recommendations of the pipe manufacturer.

3.1.2.2 Installation of ABS Composite Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make joints with the primer and solvent cement specified for this joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.2.1 Installation of Clay Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM C12 for pipe laying. Make joints with a compression joint material specified for clay pipe joints and assemble in accordance with the recommendations of the manufacturer of the pipe.

3.1.2.2.2 Installation of Concrete Gravity Sewer Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the provisions for rubber gasket jointing and jointing procedures of ACPA 01-103 or of ACPA 01-102, Chapter 9, "Installation, Inspection and Construction Testing." Make joints with the gaskets specified for concrete gravity sewer pipe joints. Clean and dry surfaces receiving lubricants, cements, or adhesives. Affix gaskets to pipe not more than 24 hours prior to the installation of the pipe. Protect gaskets from sun, blowing dust, and other

deleterious agents at all times. Before installation of the pipe, inspect gaskets and remove and replace loose or improperly affixed gaskets. Align each pipe section with the previously installed pipe section, and pull the joint together. If, while pulling the joint, the gasket becomes loose and can be seen through the exterior joint recess when the pipe is pulled up to within 1 inch of closure, remove the pipe and remake the joint.

3.1.2.2.3 Installation of Concrete Pressure Lines

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the laying and joining requirements specified in the guide specifications for installation of pipe given in AWWA M9, Chapter 14, "Guide Specifications for Installation of Pipe."

a. Joints: Make joints with the gaskets specified for concrete pressure pipe joints, using an approved lubricant recommended by the pipe manufacturer. Assemble these joints in accordance with the joining requirements specified in the guide specifications for installation of pipe given in AWWA M9, Chapter 14, "Guide Specifications for Installation of Pipe," and with the recommendations given for laying the pipe in AWWA M9, Chapter 6, "Installation by Trenching or Tunneling -- Methods and Equipment."

b. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated on the Drawings. Use concrete conforming to ASTM C94/C94M having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.2.4 Installation of Ductile Iron Gravity Sewer Pipe

Unless otherwise specified, install pipe and associated fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of AWWA C600 for pipe installation and joint assembly.

a. Make push-on joints with the gaskets and lubricant specified for this type joint and assemble in accordance with the applicable requirements SECTION 33 30 00 Page 23 02/14/12 Ames Standard Construction Specification J11008 of AWWA C600 for joint assembly. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11.

b. Exterior protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet in accordance with AWWA C105/A21.5, using Class A polyethylene film.

3.1.2.2.5 Installation of Ductile-Iron Pressure Lines

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of AWWA C600 for pipe installation, joint assembly, and valve-and-fitting installation.

a. Make push-on joints with the gaskets and lubricant specified for this

type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Make flanged joints with gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight, taking care to avoid undue strain on flanges, fittings, and other accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fittings have dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer, as approved. Make grooved and shouldered type joints with the couplings previously specified for this type joint connecting pipe with the grooved or shouldered ends specified for this type joint and assemble in accordance with the recommendations of the coupling manufacturer, as approved. Groove pipe in the field only with approved groove cutting equipment designed especially for the purpose and produced by manufacturer of grooved joint couplings; secure approval for field-cut grooves before assembling the joint.

b. Exterior protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet in accordance with AWWA C105/A21.5, using Class A polyethylene film.

c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C94/C94M having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.2.6 Installation of ABS Composite Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General SECTION 33.

3.1.2.3 Installation of ABS Solid-Wall Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make solvent cement joints with the solvent cement previously specified for this type joint. Make elastomeric joints with the gaskets specified for this type joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.4 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D 2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble

in accordance with the requirements of ASTM D 2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.5 Installation of PVC Plastic Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section; with the requirements of AWWA C605 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Pipe Less Than 4 Inch Diameter:

1. Threaded joints shall be made by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. The joints shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than 2 threads past hand-tight.

2. Push-On Joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. Care shall be exercised to ensure that the gasket remains in proper position in the bell or coupling while making the joint.

3. Solvent-weld joints shall comply with the manufacturer's instructions.

b. Pipe 4 Inch Diameter Joints: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to fittings, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of AWWA C605 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical-joints with the gaskets, glands, bolts, nuts, and internal stiffeners specified for this type joint and assemble in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel.

c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated on the Drawings. Use concrete conforming to ASTM C94/C94M having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix

not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.6 Pipeline

Installation Beneath Railroad Right-of-Way Where pipeline passes under the right-of-way of a commercial railroad, install piping in accordance with the specifications for pipelines conveying nonflammable substances in AREMA Eng Man.

3.1.3 Concrete Work

Cast-in-place concrete is included in Section 03 30 00 CAST-IN-PLACE CONCRETE. The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.1.4 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Cast-in-place concrete work shall be in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to SECTION 33 30 00 Page 26 02/14/12 Ames Standard Construction Specification J11008 construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Useconstruct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.1.5 Miscellaneous Construction and Installation

3.1.5.1 Connecting to Existing Manholes

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.1.5.2 Metal Work

a. Workmanship and finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

b. Field painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.1.6 Sewage Absorption Trench Construction

Grade pipe lines uniformly downward to the outlet. Lay perforated pipe with the perforations downward. Lay drain tile with 1/4 inch open joints. Cover open joints of drain tile with the cover material specified so that it extends not less than 100 degrees on each side of the vertical center line of the tile. Wire covering in place.

3.1.7 Installations of Wye Branches

Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The COR will conduct field inspections and witness field tests specified in this section. Perform field tests and provide labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in Section 01 45 00 QUALITY CONTROL. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. When pressure piping is used in a nonpressure line for nonpressure use, test

this piping as specified for nonpressure pipe.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C 969. Make calculations in accordance with the Appendix to ASTM C 969.

b. Low-pressure air tests: Perform tests as follows:

1. ABS composite plastic pipelines: Test in accordance with the applicable requirements of UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

2. PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.2.2.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with ASTM D 2412. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections shall conform to the following:

1. A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

2. Homogeneous material throughout, shall have a density greater than 1.0 as related to water at 39.2 degrees F, and shall have a surface Brinell hardness of not less than 150.

3. Center bored and through-bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of not less than 70,000 psi, with eyes or loops at each end for attaching pulling cables.

4. Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved prior to use.

c. Pull-through device procedure: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.

d. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, replace pipe which has excessive deflection and completely retest in same manner and under same conditions.

3.2.3 Field Tests for Concrete

Field testing requirements are covered in Section 03 30 00 CAST-IN-PLACE CONCRETE

-- End of Section --

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SECTION 40 17 26.00 20

WELDING PRESSURE PIPING

PART 1 GENERAL

1.1 SUMMARY

This section covers welding of piping and piping system components which will contain fluids under pressure including hydraulic systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0M/A3.0	Standard Welding Terms and Definitions
AWS D1.1/D1.1M	Structural Welding Code - Steel
AWS Z49.1	Safety in Welding and Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

ASME B31.1	Power Piping
ASME B31.3	Process Piping
ASME BPVC SEC II-C	BPVC Section II-Materials Part C-Specifications for Welding Rods Electrodes and Filler Metals
ASME BPVC SEC IX	BPVC Section IX-Welding and Brazing Qualifications
ASME BPVC SEC V	BPVC Section V-Nondestructive Examination

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction

1.3 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS applies to this section with the additions and modifications specified herein.

1.4 DEFINITIONS

AWS A3.0M/A3.0 and applicable AMSE/ANSI piping documents.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Welding pressure piping

Welding procedure specifications

SD-07 Certificates

Welding procedures qualification

Nondestructive examination (NDE) procedures

Nondestructive examination (NDE) records

NDE personnel certification procedures

ASME Section IX welder certification

Inspector certification

Submit inspector certification and NDE personnel certification for record. See drawings for certification submittal requirements.

SD-11 Closeout Submittals

Field Weld Drawings

Weld identifications

Weld Maps

Welding Procedures

Quality Control and Traveler's Records

1.6 QUALITY ASSURANCE

1.6.1 Welding Pressure Piping

All pipe welding shall conform fully with the applicable piping code, Show location, length, and type of welds, and indicate postweld heat treatment and nondestructive testing as required.

1.6.2 Procedures

Develop and qualify procedures for welding metals included in the work. Do not start welding until welding procedures, welders, and welding operators have been qualified. Perform qualification testing by an approved testing laboratory, or by the Contractor if approved by the COR in accordance with the qualified procedures. Notify the COR at least 24 hours in advance of the time and place of the tests. When practicable, perform the qualification tests at or near the work site. Maintain current records of the test results obtained in welding procedure, welding operator/welder performance qualifications, and nondestructive examination (NDE) procedures. These records shall be readily available at the site for examination by the COR. Qualify the procedures for making transition welds between different materials or between plates or pipes of different wall thicknesses. Applicable ASME code requirements for branch connections may be used in lieu of detailed designs. Unless otherwise specified, the choice of welding process shall be the responsibility of the Contractor.

1.6.2.1 Previous Qualifications

Welding procedures, welders, and welding operators previously qualified by test may be accepted for the work without requalification provided that the following conditions are fulfilled:

a. Copies of welding procedures, procedure qualification test records, and welder and welding operator performance qualification test records are submitted and approved in accordance with the paragraph entitled "Submittals."

b. Testing was performed by an approved testing laboratory or technical consultant or by the Contractor's approved quality control organization.

c. The welding procedures, welders, and welding operators were qualified in accordance with ASME BPVC SEC IX , AR-2 level; and base materials, filler materials, electrodes, equipment, and processes conformed to the applicable requirements of this specification.

d. The requirements of paragraph entitled "Welder and Welding Operator Performance Qualification" for renewal of qualification were met, and records showing name of employer and period of employment using the process for which qualified are submitted as evidence of conformance.

1.6.2.2 Performance

All pipe welding shall be by a U, S or PP stamp holder under their ASME quality assurance program. The Contractor shall be responsible for the quality of joint preparation, welding, and examination. Clearly identify and record materials used in the welding operations. The examination and testing defined in this specification are minimum requirements. Provide additional examination and testing as necessary to achieve the quality required.

1.6.3 Welding Procedures Qualification

Qualification of the welding procedures for each group of materials to be welded is required as indicated in ASME BPVC SEC IX. Record in detail and qualify the "Welding Procedure Specifications" for every welding procedure proposed. Qualification for each welding procedure shall conform to the requirements of ASME Standards and to this specification. The welding

procedures shall specify end preparation for welds, including cleaning, alignments, and root openings. Preheat, interpass temperature control, and postheat treatment of welds shall be as required by ASME Piping documents, unless otherwise indicated or specified. Describe the type of backing rings or consumable inserts, if used, and, if they are to be removed, the removal process. Welding procedure qualifications shall be identified individually and referenced on the shop drawings or suitably keyed to the contract drawings.

1.6.4 Welder and Welding Operator Performance Qualification

Qualify each welder and welding operator assigned to work covered by this specification by performance tests using equipment, positions, procedures, base metals, and electrodes or bare filler wires from the same specification, classification, or group number that will be encountered on his assignment. Welders or welding operators who make acceptable procedure qualification tests will be considered performance-qualified for the welding procedure used. Determine performance qualification in accordance with ASME BPVC SEC IX, and applicable ASME code as listed on drawings

1.6.5 Renewal of Qualification

Requalification of a welder or welding operator shall be required under one or any combination of the following conditions:

a. When a welder or welding operator has not used the specific welding process for a period of 3 months. The period may be extended to 6 months if the welder has been employed on another welding process.

b. There is specific reason to question the welder's ability to make welds that will meet the requirements of the specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract and a qualification test has not been taken within the preceding 12 months. Renewal of qualification under this condition need be made on only a single test joint or pipe of any thickness, position, or material to reestablish qualification for any thickness, position, or material for which the welder or welding operator had qualified previously.

1.6.6 Qualification of Inspection and (NDE) Personnel

Qualification of Inspection and Nondestructive Examination (NDE) Personnel: Qualify inspection and nondestructive examination personnel in accordance with the following requirements:

1.6.6.1 Inspector Certification

Qualify welding inspectors in accordance with ASME BPVC SEC IX.

1.6.6.2 NDE Personnel Certification Procedures

Certify NDE personnel and establish a written procedure for the control and administration of NDE personnel training, examination, and certification.

1.6.6.3 Welding Procedures and Qualifications

a. Specifications and Test Results: Submit copies of the welding procedure specifications and procedure qualification test results for

each type of welding required. Approval of any procedure does not relieve the Contractor of the responsibility for producing acceptable welds. Submit this information on the forms printed in ASME BPVC SEC IX or their equivalent.

b. Certification: Before assigning welders or welding operators to the work, submit their names, together with certification that each individual is performance qualified as specified. Do not start welding work prior to procedure qualification. The certification shall state the type of welding and positions for which each is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

1.6.7 Symbols

Conform to AWS A2.4.

1.6.7.1 Weld Identifications

Submit a list of the welders' names and symbol for each welder. To identify welds, submit written records indicating the location of welds made by each welder or welding operator.

1.6.8 Safety

Conform to AWS Z49.1, 29 CFR 1910-SUBPART Q, "Welding, Cutting, and Brazing," 29 CFR 1926-SUBPART J, "Welding and Cutting."

1.7 ENVIRONMENTAL

Do not perform welding when the quality of the completed weld could be impaired by the prevailing working or weather conditions. The COR will determine when weather or working conditions are unsuitable for welding.

1.8 DELIVERY AND STORAGE

Deliver filler metals, electrodes, fluxes and other welding materials to the site in manufacturers' original packages and store in a dry space until used. Label and design packages properly to give maximum protection from moisture and to assure safe handling.

PART 2 PRODUCTS

2.1 WELDING MATERIALS

Comply with ASME BPVC SEC II-C and IX. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

PART 3 EXECUTION

3.1 WELDING

Do not deviate from applicable codes, approved procedures and approved shop drawings without prior written approval from the COR. Materials or components with welds made off the site will not be accepted if the welding does not conform to the requirements of this specification unless otherwise specified. Assign each welder or welding operator an identifying number,

letter, or symbol that shall be used to identify his welds. Each welder or welding operator shall apply his mark adjacent to his weld using a permanent metal stamping. For seam welds, place identification marks adjacent to the welds at 3 foot intervals. Confine identification by die stamps or electric etchers to the weld reinforcing crown, preferably in the finished crater.

3.2 WELDING OPERATORS

Perform welding in accordance with qualified procedures using qualified welders and welding operators.

3.3 SUPPORTS

Welding of hangers, supports, and plates to structural members shall conform to AWS D1.1/D1.1M.

3.4 EXAMINATIONS AND TESTS

Visual and nondestructive examinations shall be performed by the Contractor to detect surface and internal discontinuities in completed welds. Employ the services of a qualified commercial inspection or testing laboratory or technical consultant . Visually examine welds. Random NDE testing applies to ASME piping unless specified otherwise. When examination and testing indicates defects in a weld joint, a qualified welder shall repair the weld in accordance with the paragraph entitled "Corrections and Repairs" of this section.

3.4.1 Random NDE Testing

Perform random NDE testing in accordance with applicable ASME piping code as listed on the drawings.

3.4.2 Visual Examination

Visually examine welds as follows:

a. Before welding -- for compliance with requirements for joint preparation, placement of backing rings or consumable inserts, alignment and fit-up, and cleanliness.

b. During welding -- for conformance to the qualified welding procedure.

c. After welding -- for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

3.4.3 Nondestructive Examination

NDE shall be in accordance with written procedures. Procedures for radiographic, liquid penetrant, magnetic particle, or ultrasonic tests and methods shall conform to ASME BPVC SEC V. The approved procedure shall be demonstrated to the satisfaction of the COR's QA personnel. In addition to the information required in ASME BPVC SEC V, the written procedures shall include:

a. Timing of the nondestructive examination in relation to the welding operations.

b. Safety precautions.

For radiographic testing program for welds, shop welds and field weld shall be considered separate lots for random examination. No less than one weld per welder shall have radiographic testing.

All butt and filler welds must be examined by magnetic particle test method or dye penetrant test method; and radiographic test as specified by applicable code and Table V.

Ultrasonic testing may not be used in lieu of radiographic testing unless approved in writing by the COR. Approval will require, but not be limited to, providing a permanent computer generated digital record of the raw ultrasonic data. A manually completed ultrasonic testing record will not suffice.

3.4.4 Review of Examinations and Tests by the Government

Examinations and tests will conform to paragraphs "Visual Examination" and "Nondestructive Examination" of this section, except that destructive tests may be required also. When destructive tests are made, qualified welders or welding operators shall make repairs using welding procedures which will develop the full strength of the members cut. Welding shall be subject to examination and tests in the mill, shop, and field.

3.5 CORRECTIONS AND REPAIRS

Remove defects and replace welds as specified in ASME Piping Standards, unless otherwise specified. Repair defects discovered between weld passes before additional weld material is deposited. Wherever a defect is removed, and repair by welding is not required, the affected area shall be blended into the surrounding surface eliminating sharp notches, crevices, or corners. After defect removal is complete and before rewelding, reexamine the area by the same test methods which first revealed the defect to ensure that the defect has been eliminated. After rewelding, reexamine the repaired area by the same test methods originally used for that area. For repairs to base material, the minimum examination shall be the same as required for butt welds. Indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no unacceptable indications are present. The use of foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

TABLE V
MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS FOR ASME B31.1 and ASME B31.3 PIPING

Weld Type	**Temperature Above 350 degrees F**	**All Others**
Buttwelds (Girth and Longitudinal)	RT for over NPS 2 and thicknesses over 3/4 inch MT or PT for all sizes and thicknesses 3/4 inch or less (see Note 8 for random RT)	MT or PT for all sizes and thicknesses (see Note 8 for random RT)
Welded Branch Connections (Size indicated is Branch Size)	RT for branch pipes over NPS 4 and thickness over 3/4 inch MT or PT for all sizes and thicknesses 3/4 inch or less (see Note 8 for random RT)	MT or PT for all sizes and thicknesses (see Note 8 for random RT)
Fillet, Socket Welds	MT or PT for all sizes and thicknesses	MT or PT for all sizes and thicknesses

NOTES:
1. Thickness refers to pressure boundary wall thickness (such as pipe wall, fitting wall, or nozzle wall thickness).
2. All welds must be given a visual examination in addition to type of specific nondestructive examination specified.
3. NPS-Nominal Pipe Size.
4. RT-Radiographic examination; MT-magnetic particle examination; PT-liquid penetrant examination.
5. RT of branch welds shall be performed before any nonintegral reinforcing material is applied.
6. The thickness of buttwelds is defined as the thicker of the two abutting ends after end preparation.
7. Temperatures and pressures shown are design.
8. In addition, provide 5 percent random RT for each lot of shop and field welds, and for each welder. Progressive sampling for examination rules per ASME B31.3, paragraph 341.3.4 shall apply.
9. For nondestructive examination, procedures, and requirements of the pressure retaining component and for acceptance criteria, refer to the standards listed in applicable code of construction or the manufacturing specifications.

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SECTION 40 95 00

PROCESS CONTROL

PART 1 GENERAL

1.1 SUMMARY

This section covers process instrumentation and control systems.

1.2 GENERAL REQUIREMENTS

a. This specification covers the equipment, materials and services to provide monitoring and controls for replacement boilers to service the NASA-Ames Arc-Jet SVS system. The SVS Steam Plant Control System will allow operators to monitor and automatically control the boilers, the new NOx system, water softener, instrument and plant air, boiler chemical feed, auxiliary boiler, and water and steam sampling.

b. The intent is to provide the specification for the design, programming, installation, verification, and testing of the software to automatically control the SVS operation. The result will be a complete and workable turn-key system that is ready for operation.

c. The boiler controllers for the Burner Management System (BMS) and the Combustion Control System (CCS) shall be able to communicate with each other and the Balance of Plant (BOP) controller using ControlNet™ over Ethernet™.

d. Existing controls for the Steam Vacuum System (SVS) and the existing boilers use Allen-Bradley hardware and Rockwell Software. The controls provided under this specification will communicate with the existing controls using ControlNet™over Ethernet™.

e. The Arc Jet Facility Data Collection System (AFDCS) is not part of the scope of this specification. The purpose of the system is to to monitor, trend, and record data from the boilers and auxiliary systems. It manages the synchronization and collection of critical status and system parameters from auxiliary collection points.

f. It is the responsibility of the SELLER to read and conform to all sections of the specifications, review and verify all applicable drawings and data sheets, and coordinate with all equipment suppliers of material specified.

g. If there is a conflict between any of the above and these requirements, the codes, standards, and NASA directives will prevail and an exception to the user specifications shall be noted.

h. All controls and equipment shall be designed, constructed, and installed in accordance with the best industry standards, methods, and practices.

1.3 REFERENCES

The publications listed below form a part of this specification to the

extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASME INTERNATIONAL (ASME)

ASME B31.8	Gas Transmission and Distribution Piping Systems

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1	Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE 142	Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book
IEEE 802.3	Standard Information Technology--Telecommunications and Information Exchange Between Systems--Specific Requirements Part 3: CSMA/CD Access Method and Physical Layer Specifications
IEEE 1100	Emerald Book IEEE Recommended Practice for Powering and Grounding Electronic Equipment

INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ISA-5.1	Instrument Symbols and Identification
ISA-5.3	Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems
ISA-5.5	Graphic Symbols for Process Displays

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 4	Terminal Blocks
NEMA 250	Enclosures for Electrical Equipment (1000

Volts Maximum)

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST SP 250	Calibration Services Users Guide

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1059	Standard for Terminal Blocks
UL 508	Industrial Control Equipment

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 60	Standards of Performance for New Stationary Sources

1.4 DEFINITIONS

Definitions, Symbols, and engineering unit abbreviations shall conform to the IEEE Stds. dictionary, as applicable.

1.5 SYSTEM DESCRIPTION

The SVS Steam Plant Control System shall be used to monitor and control the operation of the boilers and Balance of Plant equipment as specified and in accordance with the Sequence of Operation (see Appendix A for the SOO) and control schematics shown on the drawings. The control system shall provide for operator interaction, overall control system supervision, and process equipment control and monitoring. Provide hardware configured and sized to support expansion as specified and shown on the drawings.

The Instrumentation and Control (I&C) drawings, A231-1300-J001 through A231-1300-J714, are listed under "Contract Drawings" in Section 01 11 00 SUMMARY OF WORK. The Piping and Instrumentation Diagrams (P&ID) A231-1300-J701 through A231-1300-J714, are schematic representations intended to show the basic configuration. All additional control items necessary to meet the functional requirements of the sequence of operation and specifications shall be provided. Provide a complete system which is functional in all respects.

1.5.1 General Requirements

a. The control system will include a multi-user Operator Workstation (OWS) with touchscreen monitors for monitoring and control input to the BMS, CCS, and BOP systems. The workstations will be clients connected to a Human Machine Interface (HMI) server. The server will communicate with the system controllers, and will be capable of communicating with the controllers for the existing SVS and boiler controls.

b. The BOP includes the new NOx system, water softener, instrument and plant air, boiler chemical feed, auxiliary boiler, and water and steam sampling systems. These systems will communicate to the BOP Programmable Logic Controller (PLC) by way of two Remote Input/Output (RIO) cabinets located in the Boiler Area.

1.5.2 Operation

a. The control system provided under this specification shall operate using distributed PLCs for the key sub-systems, supervisory control for plant operation and automatic sequences, and a server/client architecture for the operator interface and data collection.

b. Input data to the controller shall be obtained by wiring instruments and controls to RIO modules and networking the modules to PLCs. The number and location of control panels shown on drawings shall be provided as a minimum.

c. Programming Tasks for Process Control Software includes:

1. Configuration and programming of controllers such as PLCs;

2. Configuration of server operating system and general software;

3. Configuration and programming of the human-machine interface HMI graphics, communications, data collection, trends, and reports on the server;

4. Configuration and programming of the HMI Clients; and

5. Configuration and programming of communication interfaces.

1.5.3 Points

a. Inputs to and outputs from the control system shall be in accordance with the P&IDs. Each connected analog output (AO), analog input (AI), digital output (DO), digital input (DI), and other input or output devices connected to the control system shall represent a "point" where referred to in this specification. The remote input/output (I/O) instrument point list is provided as Appendix B.

b. Instruments to be provided under this section are identified on the Instrument List provided as Appendix C.

c. Process and Environmental requirements for instruments under this section are provided in data sheets as Appendix D. Instrument manufacturer and model indicated on data sheets are examples of components that satisfy the process conditions. Functionally equivalent components by another manufacturer are acceptable.

1.5.4 Data Transmission Systems (DTS)

a. Data transmission between RIO Cabinets and the PLCs shall be provided by ControlNet™ over Ethernet™ cabling to maintain integration with the existing Arc Jet SVS systems.

b. Data transmission between the PLCs and the servers and between the servers and the clients shall be provided by TCP/IP over Ethernet™.

1.6 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

a. Detail drawings containing complete piping, wiring, schematic, flow diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

b. Piping and Instrumentation (P&ID) drawings (prepared using industry recognized device symbols, clearly defined and describing piping designations to define the service and materials of individual pipe segments and instrument tags employing Instrument Society of America suggested identifiers).

c. Include in the Drawings, as appropriate:

1. Drawing index

2. List of symbols; a series of drawings for each control system using abbreviations, symbols, nomenclature and identifiers as shown

3. Format of CAD drawings will be specified at the preconstruction conference per Section 01 78 00 CLOSEOUT SUBMITTAL

SD-03 Product Data

a. Catalog data sheets on instrumentation and cut sheets on process control hardware that show performance characteristics, dimensions, material of fabrication, installation instructions, and other characteristics necessary to ensure conformity with the design requirements. Where multiple components are shown on a catalog cut, the application specific component shall be marked.

b. Loop diagrams for all instrumentation and hardwired interlocks (one instrument and related I/O per loop drawing).

SD-06 Test Reports

a. Factory Test Procedure including a list of the equipment to be used during the testing plus manufacturer's name, model number, equipment function, the date of the latest calibration and the results of the latest calibration.

b. Notify the COR at least 72 hours before performing Functional Testing on site and at least 2 weeks before performing Functional Testing at the factory. All testing will be witnessed at the COR's discretion.

c. Factory Test Report shall refer to the actions and expected results to demonstrate that the control system performs in accordance with the sequence of operation.

d. Testing, Adjusting and Commissioning

1. Performance Verification Test(PVT)

2. Endurance Test

SD-07 Certificates

a. Calibration and Material Certifications:

1. Instruments to be calibrated by manufacturer. Calibration shall be traceable to National Institute of Standards and Technology (NIST) approved standards. Calibration ranges and accuracies to be provided by COR.

2. Calibration documentation is to be included with the instruments at time of delivery.

3. Material certification for all process-wetted materials to be included with the instrument at time of delivery.

SD-10 Operation and Maintenance Data

a. Listing of configuration parameters including factory calibration settings, if these settings are accessible by the end-user.

b. Manufacturer's operating procedures, including safety and troubleshooting procedures for instrumentation devices.

c. Manufacturer's maintenance procedures, including service schedules, recommended spare parts, and warranties for instrumentation devices.

d. Storage and handling procedure: long-term storage, humidity trimming, temperature conditioning, shelf-life limits.

e. Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. Include in the instructions layout, wiring and control diagrams of the system as installed, the manufacturer's name, model number, service manual, parts list and a brief description of all equipment and their basic operating features.

f. Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs and troubleshooting guides.

1.6.1 Storage and Handling

a. SELLER shall prepare, pack, handle, load, ship, and store all materials and equipment to prevent damage during shipping.

b. SELLER shall be responsible for any damage resulting from improper packing until acceptance.

c. Each shipment container shall include a packing list of all items contained in that shipment container. Also, a copy of each packing list shall be sent to the NASA Ames COR.

d. SELLER shall be responsible for providing any special devices needed for the delivery of any equipment and/or material.

e. SELLER shall define any heating, air conditioning, humidity control, or other storage criteria for equipment that is to be installed for regular use or is intended to be used as spare.

f. SELLER shall define long-term storage limits and maintenance procedures that are required to ensure these limits.

g. SELLER shall define shelf-life limits of all supplied equipment.

h. All openings shall be capped, plugged, or otherwise sealed against the intrusion or water, dirt, and debris. Water shall be removed from cavities to protect against damage caused by freezing and desiccant inserted.

1.7 SITE ENVIRONMENTAL CONDITIONS

a. Capacity and design of the air moving equipment and accessories shall be suitable for 24-hour full load service and to operate at a design altitude of 100 ft above sea level and in a temperature range of 35 to 100°F. Additional component specific process conditions are to be listed on the data sheets.

b. For equipment mounted at grade, the seismic coefficients are horizontal 0.8 g, and vertical 0.5 g.

PART 2 PRODUCTS

2.1 RESOURCES AND EQUIPMENT

2.1.1 Standard Products

a. Materials and equipment shall be standard unmodified products of a manufacturer regularly engaged in the manufacturing of such products.

b. Units of the same type of equipment shall be products of a single manufacturer. Items of the same type and purpose shall be identical and supplied by the same manufacturer, unless replaced by a new version approved by the Government.

2.1.2 Nameplates

a. Each major component of equipment shall have the manufacturer's name and address, and the model and serial number in a conspicuous place.

b. Each nameplate shall identify the device, such as pump "P-1" or valve "VLV-402".

c. Labels shall be coordinate with the schedules and the P&IDs.

d. Laminated plastic nameplates shall be provided for equipment devices and panels furnished.

1. Laminated plastic shall be 1/8 inch thick, white with black center core.

2. Nameplates shall be a minimum of 1 by 3 inches with minimum 1/4 inch high engraved block lettering.

3. Nameplates for devices smaller than 1 by 3 inches shall be attached by a nonferrous metal chain.

4. All other nameplates shall be attached to the device.

2.2 GENERAL REQUIREMENTS

a. Equipment located outdoors, not provided with climate controlled enclosure, shall be capable of operating in the ambient temperature

range indicated in paragraph ENVIRONMENTAL CONDITIONS, unless otherwise specified.

b. Equipment and wiring must be in accordance with NFPA 70, with proper consideration given to environmental conditions such as moisture, dirt, corrosive agents, and hazardous area classification.

c. Control equipment and terminal blocks shall comply with NEMA ICS 1 for ratings, construction and testing.

2.3 MONITORING AND CONTROL PARAMETERS

a. The control system shall be complete including sensors, field preamplifiers, signal conditioners, offset and span adjustments, amplifiers, transducers, and transmitters, control devices, engineering units, conversions and algorithms for the applications.

b. The control system shall maintain the specified end-to-end process control loop accuracy from sensor to display and final control element.

c. Connecting conductors shall be suitable for installed service.

d. Enclosures shall be rated for NEMA 4X.

2.3.1 Transmitter

a. Unless indicated otherwise, each sensor shall be provided with a transmitter, selected to match the sensor.

b. Except where specifically indicated otherwise on the drawings, the transmitter shall be provided with a four digit or analog visual display of the measured parameter and shall provide a 4 to 20 mA DC output signal proportional to the level of the measured parameter.

c. Accuracy shall be plus or minus 1 percent of full scale reading with output error not exceeding plus or minus 0.25 percent of the calibrated measurement.

d. Transmitter shall be located where indicated, mounted integrally with the sensor, pipe mounted, wall mounted or installed in the control panel. The distance between the sensor and transmitter shall not exceed the manufacturer's recommendation.

e. Field preamplifiers and signal conditioners shall be included when necessary to maintain the accuracy from sensor to the programmable logic controller or recorder.

2.3.2 Off-Gas or Vapor Service

Sensors and meters in off-gas or vapor service shall be rated for continuous duty.

2.3.3 Liquid Service

Sensors and meters in liquid service shall be rated for continuous duty service at fluid approach velocities from 2.5 ft/s to 10 ft/s with correspondingly higher constriction velocities over a fluid temperature range from 35 degrees F to 100 degrees F at pressures up to 100 psi gauge.

2.3.4 Flow Sensor

a. Liquid flow indication shall be provided as shown on the Instrument List.

b. Off-gas or Vapor flow indication shall be provided as shown on the Instrument List

c. Pressure taps shall incorporate appropriate snubbers.

d. Unless indicated otherwise, the flow transmitter shall produce a signal that is proportional to the volumetric flow rate, compensated for fluid temperature, and shall have an accuracy of plus or minus 1 percent of the actual flow.

e. Flow transmitter shall be located within 15 feet of the flow element.

f. The flow transmitter shall include a digital readout of the volumetric flow rate to 3 significant figures.

g. The controller shall provide alarms as shown on the P&IDs.

h. The transmitter shall provide a 4-20 mA DC output signal to the PLC, proportional to the measured parameter.

i. Flow rate shall be controlled to within plus or minus 1 percent of the flow setpoint.

2.3.4.1 Flow Nozzle

a. Flow nozzle shall be made of austenitic stainless steel. The inlet nozzle form shall be elliptical and the nozzle throat shall be the quadrant of an ellipse.

b. The thickness of the nozzle wall and flange shall be such that the accuracy will not be degraded by distortion of the nozzle throat from strains caused by the pipeline temperature and pressure, or methods of installing the nozzle in the pipeline.

c. The outside diameter of the nozzle flange or the design of the flange facing shall be such that the nozzle throat shall be centered accurately in the pipe.

2.3.4.2 Flow Switch

a. Flow switch shall have a repetitive accuracy of plus or minus 1 percent of actual flow setting.

b. Switch actuation shall be adjustable over the operating flow range.

c. Flow switch shall be rated for use and constructed of suitable materials for installation in the environment encountered.

d. The flow switch shall have non flexible paddle with Form C snap action contacts.

2.3.4.3 Natural Gas or Propane Flow Meter

a. Flow meter for natural gas or propane flows, corrected to standard conditions, of up to 2500 cfh shall be of the positive displacement

diaphragm or bellows type and for flows above 2500 cfh, shall be of the axial flow turbine type.

b. Meters shall be designed specifically for natural gas or propane supply metering and rated for the pressure, temperature and flow rates of the installation.

c. Permanent meters shall be suitable for operation in conjunction with an energy monitoring and control system.

d. Meter body shall be constructed of 316 stainless steel.

e. Meter shall have a minimum turndown ratio of 10 to 1 with an accuracy of plus or minus 1 percent of actual flow rate.

f. The meter index shall include a direct reading mechanical totalizing register and electrical impulse dry contact output for remote monitoring.

g. The electrical impulse dry contact output shall provide not less than 1 pulse per 100 cubic feet of gas and shall require no field adjustment or calibration.

h. The highest electrical impulse rate available from the manufacturer, not exceeding 10 pulses per second, for the installed application shall be provided.

2.3.4.4 Orifice Plate

a. Orifice plate shall be made of 316 series stainless steel sheet.

b. The outlet side of the bore shall be beveled at a 45 degree angle.

c. The thickness of the cylindrical face of the orifice shall not exceed one-fiftieth of the pipe inside diameter or one-eighth of the orifice bore, whichever is smaller.

d. The orifice plate shall be flat within 20 mils. The orifice surface roughness shall not exceed 0.02 mils.

e. The orifice plate shall be permanently identified with line size, flange rating, orifice bore diameter, plate thickness and material.

2.3.4.5 Pitot Tube

a. Each transmitter shall have a low range differential pressure sensing element and a square root extractor.

b. Sensing element accuracy shall be plus or minus 1 percent of full scale.

c. Transmitter accuracy shall be plus or minus 0.25 percent of the calibrated measurement.

d. Overall accuracy shall be plus or minus 3 percent over a range of 500 to 2500 fpm scaled to air volume.

e. The resistance to air flow shall not exceed 0.08 inch water at an air flow of 2000 fpm.

2.3.4.6 Annular Pitot Tube

a. Sensor shall have an accuracy of plus or minus 2 percent of full flow and a repeatability of plus or minus 0.5 percent of measured value.

b. Annular pitot tube shall be averaging type differential pressure sensors with four total head pressure ports and one static port made of austenitic stainless steel. The total head pressure ports shall extend diametrically across the entire pipe.

2.3.4.7 Positive Displacement Flowmeter

a. Output accuracy shall be plus or minus 2 percent of the flow range.

b. The flow meter shall be a direct reading, gerotor, nutating disk or vane type displacement device rated for liquid service.

c. A counter shall be mounted on top of the meter, and shall consist of a non-resettable mechanical totalizer for local reading, and a pulse transmitter for remote reading. The totalizer shall have a six digit register to indicate the volume passed through the meter in gallons. A sweep-hand dial will indicate down to 1 gallon.

d. The pulse transmitter shall have a hermetically sealed reed switch which is activated by magnets fixed on gears of the counter.

e. The meter shall have a bronze body with threaded or flanged connections as required for the application.

f. The maximum pressure drop at full flow shall be 5 psi gage.

2.3.4.8 Turbine Meters

Turbine meters shall be series 300 stainless steel with an accuracy of plus or minus 1 percent of actual flow from 30 percent to 100 percent of rated flow.

2.3.4.9 Insertion Turbine Flowmeter

a. Design of the flowmeter probe assembly shall incorporate integral flow, temperature, and pressure monitoring.

b. The meter flow sensing element shall operate over the temperature range with a pressure loss limited to 1 percent of operating pressure at maximum flow rate.

c. The internal temperature transmitter shall monitor the full temperature range of the fluid.

d. The integral pressure transmitter shall monitor the pressure range with end limits of 0 psi to 300 psi gauge.

e. The flowmeter electronics shall be scaled and rescaled in the field when application data changes.

f. The flowmeter shall be designed for installation in pipe sizes of 3 inches and larger to accommodate maximum probe insertion depths up to 44 inches. The retractor assembly shall have a rotor depth gage having graduations of 0.1 inches to determine exact position of turbine rotor

in the pipe.

g. The meter retractor assembly and the turbine rotor assembly shall be constructed of Series 300 stainless steel with polytetrafluoroethylene (PTFE) seals.

1. The meter retractor assembly shall be designed to protect the turbine rotor during insertion into the pipeline.

2. Retraction of the turbine rotor shall be accomplished by using a hand wheel.

3. The retractor assembly shall include an isolation valve providing a means of removal of the meter from service to allow for field maintenance and field replacement of the rotor assembly or parts.

4. The turbine rotor shall be designed to allow compensation for bearing wear without affecting rotor calibration.

h. The turbine rotor shall have an over range operating capacity of 150 percent of maximum flow for up to 5 seconds.

i. The rotor shall be calibrated at the factory in an actual flow of similar fluid over the flow range performed on test equipment with accuracy traceable to the National Institute of Standards and Technology (NIST).

1. A copy of the calibration test data, including all of the physical parameters under which the calibration tests were performed, shall be provided with each turbine rotor.

2. Calibration test data shall be analyzed to determine the rotor's arithmetic average "K" factor, the best line fit and the plus or minus deviation from these figures.

3. Turbine flowmeter accuracy shall be plus or minus 1 percent of reading for a minimum turndown ratio of 1:1 through a maximum turndown ratio of 50:1. Repeatability shall be plus or minus 0.25 percent of reading.

4. Accuracy of the transmitter shall be plus or minus 0.25 percent over the calibrated span.

5. The turbine rotor response time from minimum to maximum flow shall be less than 10 milliseconds.

2.3.4.10 Variable Area Flowmeter

a. Meters shall have an accuracy of plus or minus 1 percent of full scale.

b. The flowmeter body shall be clear acrylic plastic with brass or stainless steel end fittings.

c. The float shall be glass or stainless steel.

d. The metering tube shall be tapered and shall be provided with a direct reading flow scale engraved on the meter body.

2.3.4.11 Vortex Shedding Flowmeter

a. The accuracy shall be within plus or minus 0.8 percent of the actual volumetric flow.

b. The flow meter body shall be made of austenitic stainless steel.

c. Flowmeter shall be rated for continuous duty service at minimum pressure of 100 psi gauge.

d. The vortex shedding flowmeter body shall not require removal from the piping in order to replace the shedding sensor.

2.3.5 Level Instrumentation

a. Pressure taps shall incorporate appropriate snubbers.

b. Relays and housing shall be intrinsically safe or explosion proof as required by the NFPA hazard rating for compatibility with the contents of the tank or sump.

c. The controller shall provide alarms as shown on the P&IDs.

d. The transmitter shall provide a 4-20 mA DC output signal to the PLC, proportional to the measured parameter.

2.3.5.1 Conductivity Switch

a. The switch shall detect the presence of a fluid by measuring the electrical resistance between a sensor and a ground electrode.

b. Electrodes shall be constructed of 316 stainless steel.

c. The conductivity switch shall be capable of 2 separate level set points.

d. The switch shall use the container as a ground electrode.

e. Electrode lengths shall be as necessary, based on the application and to meet the requirements of the control sequence.

f. A relay switching point shall be provided for each sensor.

1. Switch shall have a maximum response time of 2 seconds.

2. Assembly shall be suitable for the indicated environment.

2.3.5.2 Displacement Type Level Switch

a. Liquid level switch shall be displacement type, having a minimum of two tandem floats with each float independently activating a set of Form C contacts at two different level settings.

b. Each switch shall have a narrow differential band.

c. The mounting connections shall be threaded, flanged or surface mounted to suit the application.

d. All surfaces in contact with the tank contents shall be austenitic stainless steel.

e. Each set of contacts shall be snap action, dry contact type with one normally open, and one normally closed.

f. The switch shall be actuated by a magnetically equipped stainless steel displacer. Repetitive accuracy shall be plus or minus 1/4 inch of actual displacer setting.

2.3.5.3 Mercury Float Switch

a. Float switch assemblies for use in liquid systems shall consist of wall bracket or mounting plate, galvanized steel rods, stainless steel bolts, explosion proof and corrosion resistant housing, and intrinsically safe relays.

b. Each switch shall consist of two normally open mercury switches, encapsulated in epoxy resin.

c. The float casing shall be polypropylene.

d. The switch cable shall be oil resistant thermoplastic cable with 4 No. 18 gauge stranded copper conductors, rated for 600 Volt applications.

2.3.5.4 Reed Sensor

a. Sensor shall consist of a transmitter tube with a reed strip located inside.

b. The tube length shall be of sufficient length to permit adjustment of switch actuation within process parameters.

c. A float containing a permanent magnet shall fit over the transmitter tube and shall move up and down with the liquid level. The transmitter tube and sliding float assembly shall be as required for the application as shown on the drawings.

d. Wetted parts shall be suitable for the installed service indicated.

2.3.5.5 Leak Detection

a. Double walled containment system leak detectors shall use electrodes mounted in the interstices of double walled containment systems with a minimum time delay of 0.5 seconds.

b. Leak detectors for open systems shall be mounted at slab or floor level with either a minimum time delay of 0.5 seconds or a minimum built-in-vertical adjustment of 1/8 inch to prevent activation due to high humidity.

c. Detector shall have a contact rating of 1.0A resistive or 200mA inductive at 28 VDC.

d. Leak detector panel shall indicate the location and detector causing the alarmed state.

e. The indicator shall be manual reset type.

f. A framed, non-fading half-size as-built location map in laminated plastic shall be provided for the cable leak detection system in double

containment piping systems indicating the as installed system configuration; sensing string layout shall be furnished.

g. Marks in feet along the length of pipeline interstitial cable shall be provided as references to locate leaks.

2.3.6 Pressure Instrumentation

a. Pressures shall be controlled to within plus or minus 1 percent of pressure setpoint.

b. Pressure taps shall incorporate appropriate snubbers.

c. The controller shall be provided with alarms as shown on the P&IDs.

d. The transmitter shall provide a 4-20 mA DC output signal to the PLC, proportional to the measured parameter.

2.3.6.1 Pressure Sensor

a. The sensing element shall be capsule, diaphragm, bellows, Bourdon tube, or solid state as applicable for the installation.

b. The pressure transducer shall withstand up to 300 percent of rated pressure.

c. Provide a transducer with an accuracy of plus or minus 1 percent of full scale. Scale shall be selected to put the design range of the measured pressure in the middle third of the transducer's range.

d. Pressure shall be measured in psi gauge with a range, plus or minus 1 percent of design range and shall be furnished a readout that displays 3 significant figures.

e. The transmitter output error shall not exceed 0.25 percent of measured value.

2.3.6.2 Pressure Switch

a. Sensors shall be diaphragm or Bourdon tube and shall be constructed of brass or 316 stainless steel.

b. Pressure switch shall have an accuracy of plus or minus 1 percent of the operating range.

c. Process connection shall withstand up to 150 percent of rated pressure.

d. Switch actuation set point shall be adjustable over the operating pressure range with a differential adjustment span of 20 to 40 percent of the range of the switch.

e. The switch shall have Form C snap-action contacts.

2.3.6.3 Differential Pressure

a. The sensor/transmitter assembly accuracy shall be plus or minus 1 percent of full scale.

b. The over pressure rating shall be a minimum of 300 percent of the

operating pressure.

c. Transmitter shall be suitable for installation with the low pressure connection removed.

2.3.6.4 Differential Pressure Switch

a. Each switch shall be an adjustable diaphragm, or bellows operated device, with taps for sensing lines for connection of pressure fittings designed to sense fluid pressure. For measuring air, gas or vapor stream differential pressure, these fittings shall be of the angled-tip type with tips pointing into the air stream.

b. The adjustable differential range shall be a maximum of 0.5 inches water at the low end to a minimum of 6.0 inches water at the high end.

c. Two Form C contacts shall be provided.

2.3.6.5 Pneumatic to Electric (PE) Switch

a. Each switch shall have an adjustable set point range of 3.0 to 20 psi gauge and an adjustable differential from 2.0 to 6.0 psi.

b. Contacts shall be Form C.

2.3.7 Temperature Instrumentation

a. The controller shall provide alarms as shown on the P&IDs.

b. The transmitter shall provide a 4-20 mA dc output signal to the PLC, proportional to the measured parameter.

2.3.7.1 Fluid Temperature Range

a. All devices shall be suitable for process temperatures, which define the exposure of the element, and are described in the data sheets.

b. Mercury shall not be used in thermometers.

c. Type A shall be bimetal thermometer:

1. Direct reading

2. Hermetically sealed

3. Suitable for external adjustment

4. Accurate within 1 percent of full range

5. Stainless steel construction

6. Complete with thermowell

d. Type B shall be remote reading gas/vapor thermometer:

1. Accurate within 1 percent over full range

2. Direct reading

3. Stainless steel, aluminum or phenolic case designed for panel mounting

4. Movementless design, resistant to shock and vibration and free from error created by elevation

5. Complete with armor cable, bulb, gas operated molecular sieve and ancillary components, as necessary for complete system

2.3.7.2 Resistance Temperature Detector (RTD)

a. RTD shall be platinum.

b. RTD shall have an accuracy of plus or minus 1 degrees F at the referenced temperature.

c. RTD shall be provided with a thermowell.

2.3.7.3 Continuous Averaging RTD

a. Continuous averaging RTD shall have an accuracy of plus or minus 1 degree F at the reference temperature.

b. The RTD shall be of sufficient length to ensure that the resistance represents an average over the cross-section in which it is installed.

c. The sensor shall have a bendable copper sheath.

2.3.7.4 Infrared Temperature Sensor

a. Infrared temperature sensor shall be encapsulated in series 300 stainless steel or anodized aluminum.

b. Sensor shall have an accuracy of plus or minus 1 percent of temperature measured or 2.5 degrees F, whichever is less.

2.3.7.5 Temperature Switch

a. All devices shall be suitable for process temperatures, which define the exposure of the element, and as described in the data sheets.

b. Temperature switch shall have a repetitive accuracy of plus or minus 1 percent of the operating ranges shown.

c. Switch actuation shall be adjustable over the operating temperature range.

d. The switch shall have Form C snap action contacts.

2.3.7.6 Thermocouple

a. Thermocouple shall be factory assembled with Series 300 stainless steel sheathing.

b. Wiring insulation shall be magnesium oxide.

c. Minimum insulation resistance wire to wire or wire to sheath shall be 1.5 megohm at 500 V DC.

d. Thermocouple accuracy shall be plus or minus 1.0 percent of measured value.

e. All wire/cable from thermocouple to transmitter shall be of the type necessary to match the thermocouple used. Transmitter selected shall match the type of thermocouple provided.

f. The transmitter shall include automatic cold junction reference compensation with span and offset adjustments, and upscale open thermocouple detection.

2.3.7.7 Thermowell

a. Thermowell shall be monel, brass, or copper for use in water lines; wrought iron for measuring flue gases; and austenitic stainless steel for other applications.

b. Calibrated thermowells shall be provided with threaded plug and chain, 2 inch lagging neck and inside diameter insertion neck as required for the application.

c. The thermowell shall include a connection box, sized to accommodate the temperature sensing devise.

2.3.8 Process Analytical Instrumentation

a. Probes shall be easily removable without interrupting service.

b. Sampling pumps shall be included where necessary or applicable to the sensing device.

c. For sensors integral to the electronic controller the sample may be drawn directly into the sensor or may be drawn through a sample tube. For sensors remotely located the sample may be drawn through a sample tube.

d. Outdoor sample tubes shall be heat traced.

e. Sensor and controller construction shall be suitable for operation in the monitored medium.

f. Systems requiring automated zero and calibration gas or reagents shall be provided with 14 days supply of calibration gas or reagent.

g. The controller shall provide alarms as shown on the P&IDs.

h. The transmitter shall provide a 4-20 mA DC output signal to the PLC, proportional to the measured parameter.

2.3.8.1 Oxygen Gas

a. Oxygen in air shall be monitored by an oxygen sensor and electronic controller.

b. The oxygen sensor shall be rated for continuous monitoring of the oxygen level in air in the range of 0 to 20 percent with an accuracy of plus or minus 1 percent of full scale reading.

c. The sensor response time shall be 90 percent in a maximum of 60 seconds.

d. The controller shall have automatic zeroing and shall require no normal maintenance or periodic recalibration.

e. Calculation of emission rates shall be in conformance with 40 CFR 60, Appendix A, Reference Method 19.

2.3.8.2 Total Dissolved Solids (TDS)

a. The TDS sensor shall measure the specific conductance using a conductivity sensor, displaying the total dissolved solids value in milligrams per liter (mg/L) of dissolved NaCl equivalent.

b. The transmitter will provide a 4-20mA DC analog signal for remote processing.

c. System shall be industrial grade and suitable for measurement of conductivity in a solution.

d. Sensor assembly shall be suitable for periodic removal for adjustment and cleaning without requiring shut down of the process.

e. Sensor shall be suitable for range of 0 to 10,000 milligrams per liter (mg/L) of dissolved NaCl equivalent. Range shall be field verified for the application and adjusted as required.

f. Sensing element shall be constructed of 316 stainless steel and glass, including temperature element, and be capable of continuous operation.

g. Sensing element shall be unaffected by color in the fluid, pressure, and rate of flow.

h. Sensor shall have automatic temperature compensation and shall require no normal maintenance or periodic recalibration.

2.4 CONTROL PANELS

2.4.1 Components

a. Enclosures

1. The enclosure for each control panel shall conform to the requirements of NEMA 250 for the types specified.

2. Finish color shall be the manufacturer's standard, unless otherwise indicated.

3. Damaged surfaces shall be repaired and refinished using original type finish.

4. Enclosures for installation in clean, dry indoor occupied space may be Type 1;. Enclosures for equipment installed outdoors or in mechanical equipment rooms shall be Type 4X or as shown.

5. Enclosure shall be provided with a continuously hinged door with print pocket, 3-point latching mechanism and key.

b. Standard Indicator Light

1. Indicator lights shall comply with NEMA ICS 1 and UL 508.

2. Lights shall be heavy duty, round and shall mount in a 0.875 inch mounting hole.

3. Indicator lights shall be LED type and shall operate at 120 VAC or 24 VDC.

4. Indicator light shall be provided with a legend plate labeled as shown on the drawings.

5. Lens color shall be as indicated on the drawings. Lights shall be push to test (lamp) type.

c. Selector Switches

1. Selector switches shall comply with NEMA ICS 1, NEMA ICS 2 and UL 508.

2. Selector switches shall be heavy duty, round and shall mount in a 0.875 inch mounting hole.

3. The number of positions shall be as indicated on the drawings.

4. Switches shall be illuminated as indicted on the drawings.

5. Switches shall be rated for 120 VAC, 10 amperes continuous.

6. Selector switches shall be provided with a legend plate labeled as shown on the drawings.

7. Where indicated or required, dual auxiliary contacts shall be provided for the automatic position to provide position sensing at the central station or workstation.

8. Auxiliary contacts shall be rated for 120 VAC, 1A as a minimum.

9. Where indicated on the drawings, switches shall be key operated. All keys shall be identical.

d. Push Buttons

1. Push buttons shall comply with NEMA ICS 1, NEMA ICS 2 and UL 508.

2. Push buttons shall be heavy duty, round and shall mount in a 0.875 inch mounting hole.

3. The number and type of contacts shall be as indicated on the drawings or required by the Sequence of Control.

4. Push buttons shall be rated for 120 VAC, 10 amperes continuous.

5. Push buttons shall be provided with a legend plate labeled as shown on the drawings.

e. Relays

1. Relay coils shall be 24 VDC or 120 VAC.

2. Power consumption shall not be greater than 3 watts.

f. Terminal Blocks

1. Terminal blocks shall comply with NEMA ICS 4 and UL 1059.

2. Terminal blocks for conductors exiting control panels shall be two-way type with double terminals, one for internal wiring connections and the other for external wiring connections.

3. Terminal blocks shall have full deep barriers between each pair of terminals.

4. A terminal identification strip shall form part of the terminal block.

5. Each terminal shall be identified by a number in accordance with the numbering scheme on the approved wiring diagrams.

g. Alarm Horns

1. Alarm horns shall be provided where indicated on the drawings.

2. Horns shall be vibrating type and shall comply with UL 508.

3. Horns shall provide 100 dB at 10 feet.

4. Exterior mounted horns shall be weather proof by design or shall be mounted in a weather proof enclosure that does not reduce the effectiveness of the horn.

h. Panel Assembly

1. Control panels shall be factory assembled and shipped to the jobsite as a single unit.

2. Panels shall be fabricated as indicated and devices shall be mounted as shown or required.

3. Each panel shall be fabricated as a bottom-entry connection point for control system electrical power, control system wiring, and communications system wiring to other control panels.

i. Electrical Requirements

1. Each panel shall be powered by a dedicated 120 VAC circuit, with a 20 amp fuse.

2. A disconnect switch located inside the panel shall be provided.

3. Wiring shall terminate inside the panel on terminal blocks.

4. Electrical work shall be as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and as shown on the drawings.

j. Grounding

1. Control panel enclosures shall be equipped with a solid copper ground bus or equivalent.

2. The ground bus shall be securely anchored to the enclosure so as to effectively ground the entire structure.

3. Clamp-type terminals sized large enough to carry the maximum expected current shall be provided on the ground bus for grounding cables.

4. Where a definite circuit ground is required, a single wire not less than #10 AWG shall run independently to the panel ground bus and shall be fastened to the ground bus with a bolted terminal lug.

5. Cases of instruments, relays and other devices shall be effectively grounded through the enclosure's steel structure unless otherwise indicated.

6. Insulated wiring having a continuous rated current of not less than the circuit fuse rating shall be used for grounding.

7. Grounding terminals of power receptacles shall be solidly grounded to the panel enclosure.

k. Convenience Outlet

1. A 120 VAC, 20 amp, ground fault interruption (GFI) type duplex convenience outlet shall be provided inside the panel.

l. Panel Interior Light

1. Each control panel shall be provided with a fluorescent light.

2. The light shall be operated by a manual on-off switch mounted on the interior door of the enclosure.

m. Ventilation System

1. Where indicated, control panels shall be provided with 120 VAC ventilation fans.

2. Each fan shall supply a minimum of 100 CFM of ventilation air through the enclosure.

3. Each fan shall be provided with a line voltage thermostat.

a) Thermostat setpoints shall be adjustable in a range of 70 to 140 degrees F as a minimum.

4. Each supply and exhaust grille shall contain a filter that is easily removed for cleaning or replacement.

2.5 PLC CONTROLLERS

2.5.1 PLC General Requirements

a. The SVS Steam Plant Control System is comprised of a number of PLC controllers, all capable of communicating with each other:

1. The Burner Management System (BMS) for each of the three boilers requires dedicated PLCs to provide flame safety functions.

2. The Combustion Control System (CCS) for each of the three boilers requires dedicated PLCs to provide software controls for fuel flow, air flow, oxygen trim and feedwater.

3. The Boiler Master PLC controls the selection of the boilers (2 out of 3) and the selection of the feedwater pumps (2 out of 3).

4. The Balance of Plant (BOP) PLC monitors and/or controls boiler plant support systems including:

   a) Water Softener
   b) Deaerator Level and Pressure
   c) Boiler Feedwater Pumps
   d) Main Steam Pressure Regulation
   e) Boiler Chemical Feed
   f) Auxiliary Boiler
   g) Blowdown System
   h) Water and Steam Sampling
   i) Instrument and Plant Air
   j) Emissions Monitoring

   The BOP controls and the Boiler Master may be programmed in the same PLC.

5. The control valve that selects between domestic water and reverse osmosis (RO) water is operated by a dedicated controller, designated as PLC-RO. The controller shall be compatible with those currently used by the RO project (Allen-Bradley 1769-L35E CompactLogix). The control algorithm will be provided by the RO project personnel.

6. The Steam Vacuum System (SVS) controller is not within the scope of this specification.

b. PLCs shall be capable of receiving discrete and analog inputs and shall be able to: control discrete and analog output functions, perform data handling operations, and communicate with external devices.

c. PLCs shall function properly at temperatures between 32 and 120 degrees F at 5 to 95 percent relative humidity non-condensing and shall tolerate storage temperatures between minus 40 and plus 140 degrees F at 5 to 95 percent relative humidity non-condensing.

d. PLCs shall be based on a modular, field expandable design allowing the system to be tailored to the process control application. The system shall be expandable through the use of additional hardware and/or user software.

e. As a minimum, the PLC shall include a mounting backplane, power supply module, central processing unit (CPU) module, communications module, and input/output (I/O) module.

f. The system configuration shall allow for the removal and/or installation of modules under power.

2.5.2 Central Processing Unit (CPU) Module

The CPU module shall be a self contained, microprocessor based unit that

provides time of day, scanning, application (ladder rung logic) program execution, storage of application programs, storage of numerical values related to the application process and logic, I/O bus traffic control, peripheral and external device communications and self diagnostics.

2.5.3 Communications Module

a. The communications module shall allow peer-to-peer communication with other PLCs and shall allow the PLC to communicate with the central station, or workstation.

b. The control network shall be standardized to ControlNet™ over Ethernet™.

c. The communication module shall allow programming of the PLC to be done locally through the use of a laptop computer or from the central station or remote workstation.

2.5.4 Power Supply Module

a. One or more power supply modules shall be provided as necessary to power other modules installed in the same cabinet.

b. Power supply modules shall plug directly into the backplane. Auxiliary power supplies may be used to supply power to remote cabinets or modules.

c. The power supply module shall monitor the incoming line voltage level and shall provide over current and over voltage protection.

d. If the voltage level is detected as being out of range the power supply module shall continue to provide power for an adequate amount of time to allow for a safe and orderly shutdown.

e. Power supply modules shall be capable of withstanding a power loss for a minimum of 20 milliseconds while still remaining in operation and providing adequate power to all connected modules.

f. Each power supply module shall be provided with an on-off switch integral to the module.

g. If the manufacturer's standard power supply module is not provided with an on-off switch, a miniature toggle type switch shall be installed near the PLC and shall be clearly labeled as to its function.

h. Power supply modules shall be provided with an indicating light which shall be lit when the module is operating properly.

2.5.5 Input/Output (I/O) Modules

a. Each module shall contain visual indication to display the on-off status of individual inputs or outputs.

b. Each controller shall allow for analog input, analog output, discrete input, discrete output and RTD input.

c. The number and type of inputs and outputs for the system shall be as shown on the P&IDs.

d. The system capacity shall include a minimum of 20 percent spare input and output points (no less than two points) for each point type provided.

e. During normal operation, a malfunction in any input/output channel shall affect the operation of that channel only and shall not affect the operation of the CPU or any other channel.

f. Analog input circuits shall be available in +/-10 VDC, +/-5 VDC, 0-10 VDC, 0-5 VDC, and 4-20 mA as needed by the application.

g. Discrete input circuits shall be available in 5 VDC, 24 VDC, 110 VAC as needed by the application.

h. All input circuits shall have optical isolation and shall be filtered to guard against high voltage transients from the externally connected devices.

i. Analog output circuits shall be available in +/-10 VDC, or 4-20 mA as needed by the application.

j. Discrete output circuits shall be available in 5 VDC 24 VDC or 110 VAC relays as needed by the application.

k. All output circuits shall have optical isolation and shall be filtered to guard against high voltage transients from the externally connected devices.

2.5.6 Program Storage/Memory Requirements

a. The CPU shall utilize the manufacturer's standard non-volatile memory for the operating system.

b. The memory capacity shall be sized such that, when the system is completely programmed and functional, no more than 50 percent of the memory allocated for these purposes is used.

c. The controller shall have battery backed RAM for application memory.

d. The program shall be loaded through the use of a networked computer.

2.5.7 Wiring Connections

a. Wiring connections shall be heavy duty, self lifting, screw terminals to provide easy wire insertion and secure connections.

b. The terminals shall accept two #14 AWG wires.

c. A hinged protective cover shall be provided over the wiring connections.

d. The cover shall have a means for identification of the external circuits.

2.5.8 Diagnostics

a. Each PLC shall have diagnostic routines implemented in firmware.

b. The CPU shall continuously perform self-diagnostic routines that will provide information on the configuration and status of the CPU, memory,

communications and input/output.

c. The diagnostic routines shall be regularly performed during normal system operation. A portion of the scan time of the controller shall be dedicated to performing these housekeeping functions.

d. In addition, a more extensive diagnostic routine shall be performed at power up and during normal system shutdown.

e. The CPU shall log input/output and system faults in fault tables which shall be accessible for display. When a fault affects input/output or communications modules the CPU shall shut down only the hardware affected and continue operation by utilizing the healthy system components.

f. All faults shall be annunciated at the PLC and the Operator Workstation.

g. Diagnostic software shall be useable in conjunction with the portable tester.

2.5.9 Accuracy

Controllers shall have an accuracy of plus or minus 0.25 percent of input span.

2.6 PLC SOFTWARE

All PLC software described in this specification shall be furnished as part of the complete control system. The delivered PLC software shall include sufficient run-time licenses for all PLCs in the system. At least one PLC software development license shall be provided.

2.6.1 Operating System

a. The manufacturer's standard operating system software package shall be provided with each PLC.

b. The PLC shall maintain a point database in its memory that includes all parameters, constraints and the latest value or status of all points connected to the PLC.

c. Execution of the PLC application programs shall use the data in memory resident files.

d. The operating system shall support a full complement of process control functions. It shall be possible to define these functions using a mix of function blocks, ladder logic diagrams, sequential function charts and text programming.

e. A combination of the programming methods shall be possible within a single controller.

f. The operating system shall allow loading of software locally or remotely.

g. Each PLC shall be capable of operating in standalone mode.

2.6.2 Startup

a. The PLC shall have startup software that causes automatic commencement of operation without human intervention, including startup of all connected I/O functions.

b. A PLC restart program based on detection of power failure at the PLC shall be included in the PLC software.

   1. The restart program shall include start time delays between successive commands to prevent demand surges or overload trips.

2.6.2 Failure Mode

Upon failure for any reason, each PLC shall perform an orderly shutdown and force all PLC outputs to a predetermined (failure mode) state, consistent with the failure modes shown and the associated control device.

2.6.3 State Variables

If an analog point represents more than two specific states, each state shall be nameable. For example, a level sensor shall be displayed at its measured engineering units plus a state variable with named states usable in programs or for display such as low alarm/low/normal/high/high alarm.

2.6.4 Alarm Processing

a. Each PLC shall have alarm processing software for all real and virtual points connected to that PLC.

b. Analog alarms are those conditions higher or lower than a defined value, as measured by an AI. Analog readings shall be compared to predefined high and low limits, and alarmed each time a value enters or returns from a limit condition.

c. Unique high and low limits shall be assigned to each analog point in the system as defined in the instrument list.

d. The system shall automatically suppress analog alarm reporting associated with an analog point when that analog point is turned off.

2.6.5 Control Sequences and Control Loops

Specific functions to be implemented are defined in the sequence of operation and shown on the drawings. Functions shall include, as applicable, the following:

a. PI control shall provide proportional control and proportional plus integral control;

b. two position control shall provide control for a two state device by comparing a set point against a process variable and an established dead band;

c. floating point control shall exercise control when an error signal exceeds a selected dead band, and shall maintain control until the error is within the dead band limits;

d. signal selection shall allow the selection of the highest or lowest

analog value from a group of analog values as the basis of control and shall include the ability to cascade analog values so that large numbers of inputs can be reduced to one or two outputs;

e. signal averaging shall allow the mathematical calculation of the average analog value from a group of analog values as the basis of control and shall include the ability to "weight" the individual analog values so that the function output can be biased as necessary to achieve proper control;

2.6.6 Command Priorities

a. A scheme of priority levels shall be provided to prevent interaction of a command of low priority with a command of higher priority. Override commands entered by the operator shall have higher priority than those emanating from applications programs.

b. Use program inputs listed for each application program to calculate the required program outputs. Where specific program inputs are not available, a "default" value or virtual point appropriate for the equipment being controlled and the proposed sequence of operation shall be provided to replace the missing input, thus allowing the application program to operate.

c. In the event of a PLC failure, the controlled equipment shall continue to function in the failure mode shown on the drawings.

2.7 SERVERS AND WORKSTATIONS

2.7.1 HMI Server

a. The HMI Server shall have a rack mounted configuration and be provided with a minimum of:

1. CPU: Intel Pentium 4 Duo 3 GHz processor

2. Hard drive: 160 GB, 7200 RPM SATA

3. Other Drives: 16X DVD+/-RW

4. Random Access Memory (RAM): 4 GB of RAM

5. Network Cards: Intel 3 Gigabit Network Card (on-board)

6. 17" 1U Rack LCD/Keyboard/Mouse with 8 Port KVM built in

2.7.2 Operator Workstation

Workstation Computer shall have a standard tower configuration and be provided with a minimum of:

a. CPU: Intel Pentium 4 Duo 3 GHz processor

b. Hard drive: 160 GB, 7200 RPM SATA

c. Other Drives: 16X DVD+/-RW

d. Random Access Memory (RAM): 4 GB of RAM

e. Network Cards: Intel 3 Gigabit Network Card (on-board)

f. SVGA Color Monitor Touchscreen with software

1. SVGA color monitor shall be no less than 21 inches, with a minimum resolution of 1280 by 1024 pixels, non-interlaced, and a maximum dot pitch of 0.28 millimeters.

2.7.3 Programming/Diagnostic Laptop

a. CPU: Intel CoreTM i7

b. Hard drive: 256 GB

c. Other Drives: DVD+/-RW

d. Random Access Memory (RAM): 4 GB of RAM

e. Built-in Network Connectivity: 10/100/1000 Gigabit Ethernet™

f. Display: 15.6-inch (resolution of 1920x1080 pixels) Anti-Glare LED

2.7.4 Printer

a. A color laser printer shall installed in the Building 231 Control Room.

b. The printer shall have an Ethernet™ network interface.

c. Printing speed shall be a minimum of 4 pages per minute.

d. The size for paper and other media shall be 8.5 X 11 inches.

e. The paper cassette shall have a 250 sheet minimum capacity.

2.7.5 LAN System

a. The local area network (LAN) shall be used to allow communication between PLCs located in the control panel, the operator's workstation computer and the printer.

b. The LAN system configuration and hardware shall comply with the control system schematics and block diagram shown on the drawings and Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM. All LAN equipment shall fully comply with IEEE 802.3 1000 BASE T) Ethernet™ networks.

c. LAN Switches

1. Network switches shall provide communication between network devices using network cables.

2. Network switches shall be modular and sized to provide 20 percent spare ports.

a) Each port shall have LED indicator for network monitoring status.

3. Network switches shall permit online network changes without disturbing network devices.

4. Malfunctioning network devices shall be automatically removed from service without shutting down the network.

2.7.6 Uninterruptible Power Supply (UPS)

a. A self contained UPS suitable for installation and operation as shown on the drawings shall be provided.

b. The unit shall be sized to provide a minimum of 20 minutes of operation.

c. The UPS shall incorporate:

1. Surge suppression

2. Noise filtering (normal and common mode)

3. Short circuit protection and voltage regulation (brownout and overvoltage protection).

4. All necessary power supplies, transformers, batteries, and accessories

5. Visual indication of normal power operation, UPS operation, abnormal operation and visual and audible indication of low battery power

6. Communication with load to initiate orderly shutdown.

d. The UPS shall comply with the Federal Communications Commission Standard 15J part A for radio noise emissions.

2.8 HMI SERVER SOFTWARE

a. The HMI server software shall provide the communication, programming and control capabilities necessary to support all specified points and functions, plus a minimum expansion of 20 percent of the current number of points, complete with their point database.

b. The HMI server software shall be Rockwell Software's FactoryTalk™ SE Server. This software package allows the import of Panelview™ screens and ensures the full integration of all the site controllers.

c. The HMI server shall be provided with all the hardware, software, and licenses necessary to troubleshoot, modify and create new graphic screens.

d. A library of callable display symbols containing symbols for all necessary equipment and control devices shall be furnished.

e. The operator workstations shall run FactoryTalk View SE™ Clients

2.8.1 Graphical Interface

a. System graphics displays shall be hierarchical displays which integrate dynamic data into the display.

b. Navigation for the screens will allow access to any screen from any other screen with no more than two jumps.

c. Each system schematic shall be included as a separate display.

d. Graphic screens shall conform to:

1. ISA-5.1, Instrument Symbols and Identification

2. ISA-5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems

3. ISA-5.5, Graphic Symbols for Process Displays

e. Data associated with a display shall be updated within 2 seconds.

f. Any dynamic data which is not current, due to PLC communications failure, PLC failure, or point out of service, shall be highlighted or flagged.

g. The user shall be able to display data in chart formats using:

1. Pre-defined trend charts, and user configurable charts

2. Pre-defined historical charts, and user configurable charts

h. The user shall be able to call up the displays by dedicated function key, pull down menu or by icon and shall be able to page forward and backward on linked multiple page displays.

i. In addition to process and system screens, the following shall be provided:

1. System Menu (list of all graphics and menus).

2. Alarm Summary (list of all uncleared alarms).

3. Alarm History (keeps track of alarm conditions which have been cleared).

4. Data Communications Summary (listing of availability for each communication channel, by statistically processing the number of transmission errors, outages, and other abnormal conditions for each channel).

j. The workstations shall be able to obtain a hard copy of the monitor display being viewed. This shall be an exact "snapshot" of the data and device symbols shown on the selected monitor.

2.8.2 Command Input

a. Command menus shall utilize full words and acronyms selected to allow operators to use the system without extensive training or data processing backgrounds.

b. The system shall supervise operator inputs to ensure they are correct for proper execution. Operator input assistance such as message screens shall be provided whenever a command cannot be executed because of operator input errors.

c. The system shall support the following special functions by using a

mouse or touchscreen interface, in addition to all other commands specified:

1. All operations shall require the operator to confirm that the de sited command sequence has been correctly entered and is to be executed.

2. Cancel action shall quit the command sequence without execution.

3. Start/Enable shall manually start equipment and enable monitoring and control of points.

4. Stop/Disable shall manually stop equipment and disable monitoring and control components.

5. Auto/Override shall override automatic operation of a point or return a point to automatic operation.

6. Print Report shall allow the operator to print pre-defined reports.

2.8.3 System Access Control

A minimum of four password levels shall be made available with the control system software.

a. Operator:

1. There will not be a login required of the Operator Security level when the computer system restarts.

2. If logout is pushed the operator username will be "oper" with no password required.

3. The operator will have access to operate the processes of the facility. This includes the operation of valves, pumps, heaters, and samplers.

b. Maintenance:

1. The maintenance security level will have access to the operator functions plus access to change setpoints.

c. Supervisor:

1. The Supervisor security level will only have access to enable or disable equipment and over-ride interlocks.

d. Administrator:

1. This level will have necessary permissions to develop and modify screens, the HMI database, and the historical display charts. The System Administrator will have access to all functions associated to the Maintenance, Supervisor, and Operator security levels.

2. The system shall log all operators logged onto the system, alarm acknowledgments, commands issued and all database modifications for each password.

2.8.4 Alarms

a. The software shall notify an operator of the occurrence of an alarm condition.

   1. An active, unacknowledged alarm shall flash red and yellow.

   2. A cleared, unacknowledged alarm shall flash red and background.

   3. An active, acknowledged alarm shall display solid red.

b. Process screens shall show an alarm summary of the most recent 3 alarms.

c. A minimum of the most recent 25 system alarms shall be available on an alarm screen.

d. The control system alarm history shall be stored in an ASCII file and shall be recallable by the operator using the report generator.

e. Alarm messages shall take precedence over other functions.

f. Operator acknowledgment of one alarm shall not be considered as acknowledgment of any other alarm nor shall it inhibit reporting of subsequent alarms.

g. Alarm data to be displayed and stored shall include:

   1. Tagname of the instrument in alarm

   2. Identification of the alarm

   3. Date and time to the nearest second of occurrence,

   4. Device or sensor type

   5. Limit exceeded (if analog) including engineering units

   6. Current value or status

   7. Alarm messages

2.8.5 Pop-up Note Function

A pop-up note function shall be included providing the operator a capability of recording any general reminders or instructions which may be associated with alarms or with any other event. A note created by an operator shall be automatically called up when any other workstation calls up the associated point.

2.8.6 Real Time Clock Synchronization

The system shall synchronize each workstation computer, real time clock, within one second and at least once per day automatically, without operator intervention and without requiring system shutdown.

2.8.7 Historical Data Storage and Retrieval

a. A historical data storage and retrieval function shall be provided at the HMI server to collect and store dynamic data.

b. The function shall have the capability to collect and store:

1. Alarm status changes

2. Point values

3. Events and operator commands

c. The storage function shall have the capability to collect and store analog data at pre-specified sampling rates.

1. This function shall have the capability to retain historical data on hard disk for pre-specified time periods, up to forty five days using last day roll over, for short-term analysis, and then output the data to the removable media for long-term retention.

2. The operator shall also be able to selectively recall short-term data stored on hard disk. Retrieval and printing of the contents of any selected historical data file shall be available using the data retrieval and report generation program. The output of the report generation program shall be capable of being viewed on the screen, printed in a report, or stored.

2.8.8 Report Generator

a. Software shall be provided to generate and format standard and custom reports for displaying, printing, and storing on disk.

b. Reports shall use database values and parameters, values calculated using real time data or the historical data base.

1. Dynamic operation of the system shall not be interrupted to generate a report.

2. The report shall contain the time and date when the sample was taken, and the time and date when the report was printed.

c. The system shall be able to provide periodic automatic reports.

2.8.9 Trending

a. Any current, historical or calculated point shall be operator assignable to the trend program.

b. Points shall be sampled at individually assigned intervals, selectable between one minute and 24 hours.

c. The system shall automatically store the accumulated trend data to an ASCII disk file.

d. Operator shall be able to choose the start time and duration of the trends.

e. Operator shall be able to choose a static trend, or have it automatically update.

f. The operator shall be able to print a hardcopy of the trend.

2.8.10 Analog Monitoring

a. The system shall measure, transmit, and display analog values, including calculated analog points as described on the drawings.

b. Differential measurements shall be displayed as positive or negative values with respect to their reference points shown.

2.9 FACTORY TEST

a. The contractor shall submit a factory test procedure to the Government for approval.

b. The control system shall be tested at the factory prior to shipment.

1. Written notification of planned testing shall be given to the Government at least 21 days prior to testing.

2. In no case shall notice be given until after the Contractor has received written Government approval of the test procedures.

2.9.1 Factory Test Setup

a. Assemble and integrate the factory test setup as specified to prove that performance of the system satisfies all requirements of this project, including system communications requirements in accordance with the approved test procedures.

b. The factory test shall take place during regular daytime working hours on weekdays. Equipment used shall be the same equipment that is to be delivered to the site.

c. The factory test setup shall include the following:

Factory Test

HMI Server	one each of the components
workstation	one of each type
control panel	one of each type
test set	one of each type
portable tester	one of each type
communications circuits	one of each type and speed to be utilized in the proposed system including bridges, modems, encoder/decoders, transceivers and repeaters
surge protection equipment	for power, communications, I/O functions and networks
I/O functions	sufficient to demonstrate the I/O capability and system normal

software	software required for proper operation of the proposed system including application programs and sequence of operation

2.9.2 Factory Test Procedure

a. Test procedures shall define the tests required to ensure that the system meets technical, operational, and performance requirements.

b. The test procedures shall define location of tests, milestones for the tests, and identify simulation programs, equipment, personnel, facilities, and supplies required.

c. The test procedures shall provide for testing all control system capabilities and functions specified and shown.

d. The procedures shall cover actual equipment and sequences to be used by the Contractor for the specified project and shall consist of detailed instructions for test setup, execution, and evaluation of test results.

e. The test reports shall document results of the tests.

f. Reports shall be delivered to the Government within 7 days after completion of each test.

g. Surge testing need not be conducted if the Contractor can provide acceptable documented proof that such testing has been satisfactorily demonstrated to the Government with identical surge protection applied.

h. The procedures shall include the following:

Test Procedure

equipment	block diagram
hardware and software	descriptions
commands	operator commands
I/O functions	test database points with failure modes
passwords	required for each operator access level
each type of digital and analog point in the test database	description
test equipment	list
surge protection	circuit diagrams

inputs required (I/O point values and status) and corresponding expected results of each set of input values	for each application program
default values	for the application program inputs not implemented or provided for in the contract documents for the application programs to be tested

2.9.3 Factory Test Report

a. Original copies of data produced during the factory test, including results of each demonstration procedure, shall be delivered to the Government at the conclusion of the test, prior to Government approval of the factory test.

b. The report shall be arranged so that commands, responses, and data acquired are correlated to allow logical interpretation of the data.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION REQUIREMENTS

3.1.1 Installation

a. Install system components in accordance with the manufacturer's instructions and provide necessary interconnections, services, and adjustments required for a complete and operable system.

b. Installation shall provide clearance for control-system maintenance. Control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

c. Instrumentation and communication equipment and cable grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation. All grounding shall comply with IEEE 1100.

d. Adjust or replace devices not conforming to the required accuracies.

   1. Factory sealed devices shall be replaced (rather than adjusted).

3.1.2 Wiring

a. Wiring in exposed areas, including low voltage wiring, shall be installed in metallic raceways or EMT conduit as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

b. Wiring in air plenum areas installed without conduit shall be plenum-rated in accordance with NFPA 70.

3.1.3 Isolation, Penetrations and Clearance from Equipment

a. Dielectric isolation shall be provided where dissimilar metals are used for connection and support.

b. Penetrations through and mounting holes in the building exteriors shall be made watertight.

1. Holes in concrete, brick, steel and wood walls shall be drilled or core drilled with proper equipment;

2. Conduits installed through openings shall be sealed with materials which are compatible with existing materials;

3. Openings shall be sealed with materials which meet the requirements of NFPA 70.

3.1.4 Device Mounting

a. Devices shall be installed in accordance with manufacturers' recommendations and as shown.

b. Control devices to be installed in piping shall be provided with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration.

c. Any deviations shall be documented and submitted to the Government for approval prior to mounting.

d. Damaged insulation shall be replaced or repaired after devices are installed to match existing work.

e. Damaged galvanized surfaces shall be repaired by touching up with zinc paint.

3.1.5 Pneumatic Tubing

a. Tubing shall be concealed in finished areas.

b. Tubing may be run exposed in unfinished areas, such as mechanical equipment rooms.

c. For tubing to be enclosed in concrete, rigid metal or intermediate metal conduit shall be provided.

d. Tubing shall be installed parallel or perpendicular to building walls throughout.

e. Maximum spacing between tubing supports shall be 5 feet.

f. Each tubing system shall be tested pneumatically at 1.5 times the working pressure for 24 hours, with a maximum pressure drop of 1.0 psig with compressed air supply turned off. Joint leaks shall be corrected by remaking the joint. Caulking of joints will not be permitted.

g. Tubing and two insulated copper phone wires for installation checkout may be run in the same conduit. Tubing and electrical power conductors shall not be run in the same conduit; however, control circuit conductors may be run in the same conduit as polyethylene tubing.

3.1.6 Sequence of Operation

a. Study the operation and sequence of local equipment controls, as a part of the conditions report, and note any deviations from the described sequence of operation on the contract drawings.

b. Perform necessary adjustments to make the equipment operate in an optimum manner. Fully document changes made.

3.2 INSTALLATION OF EQUIPMENT

3.2.1 Equipment

Install equipment as specified, as shown and as required in the manufacturer's instructions for a complete and fully operational control system.

3.2.2 Control Panels

Control panels shall be located as indicated on the drawings. Devices located in the control panels shall be as shown on the drawings or as needed to provide the indicated control sequences.

3.2.3 Flow Measuring Device

a. Fluid flow instruments shall be installed in accordance with manufacturer's recommendations, unless otherwise indicated in the specification.

b. The minimum straight unobstructed piping for the flowmeter installation shall be as shown on the drawings.

c. Meters for gases and vapors shall be installed in vertical piping, and meters for liquids shall be installed in horizontal piping, unless otherwise recommended by the manufacturer or indicated in the specifications.

3.2.4 Flow Nozzle

a. Flow nozzle flanges shall be installed so that the pressure taps are in a horizontal plane with the centerline of the pipe.

b. Flow nozzles shall be installed for ease of accessibility for periodic maintenance.

c. Differential pressure sensors shall be installed as close to the flow nozzle as possible.

3.2.5 Flow Switch

Flow switches shall be installed in such a manner as to minimize disturbance of the flow of fluid while maintaining reliable operation of the switch.

3.2.6 Natural Gas or Propane Flowmeter

a. Meters shall be installed in accordance with ASME B31.8.

b. Permanent gas meters shall be installed with provisions for isolation and removal for calibration and maintenance.

c. Permanent gas meters shall be suitable for operation in conjunction with an energy monitoring and control system.

3.2.7 Orifice Plates

a. Orifice plates shall be installed for ease of accessibility for periodic maintenance.

b. Differential pressure sensors shall be as close to the orifice plates as possible.

c. Orifice plates for liquid measurement shall be located in horizontal pipe runs with the orifice plate flanges installed so that the pressure taps are in the horizontal plane with the centerline of the pipe.

   1. For liquid, the differential pressure transmitter shall be installed below the orifice taps.

   2. For gas measurement, the orifice plate flanges shall be installed so that the pressure taps are 45 degrees or more above the horizontal plane with the centerline of the pipe.

   3. For gas measurement the required differential pressure transmitter shall be physically installed above the orifice taps.

3.2.8 Annular Pitot Tubes

a. Annular pitot tubes shall be installed so that the total head pressure ports are set-in-line with the pipe axis upstream and the static port facing downstream.

b. The total head pressure ports shall extend diametrically across the entire pipe.

c. Annular pitot tubes shall not be used where the flow is pulsating or where pipe vibration is allowed.

3.2.9 Positive Displacement Flow Meters

Flow meters shall be installed horizontally, and aligned correctly in the direction of flow.

3.2.10 Turbine Meters

a. Turbine meters shall be installed so that the sensor is located in the center of the fluid flow pipe on the main axis.

b. The minimum straight unobstructed piping for the flow meter installation shall be as shown on the drawings.

3.2.11 Insertion Turbine Flowmeters

a. Turbine meters shall be installed without interruption to service. Install a welded flanged riser of appropriate pipe line rating, with a full opening valve bolted to it.

b. Sensor shall be located in accordance with the manufacturer's instructions for the specified flow rates and installation conditions.

c. Reduced diameter pipe sections shall be provided as necessary to achieve required flow velocities.

d. Meters shall be installed using the hot-tap method with tools recommended by the manufacturer.

e. The minimum straight unobstructed piping for the flow meter installation shall be as shown on the drawings.

3.2.12 Variable Area Flowmeter

Meters shall be installed in a vertical piping section with full flow through the meter.

3.2.13 Vortex Shedding Flowmeters

a. The flowmeter shall be installed with its top above the pipeline in horizontal pipe run installations.

b. The direction of flow shall be upward in vertical pipe run installations.

c. The flowmeter shall be aligned to the direction of the flow and shall be rigidly mounted and vibration free.

d. The minimum straight unobstructed piping for the flow meter installation shall be as shown on the drawings.

3.2.14 Level Instruments

a. Conductivity Switch

1. Level switches shall be installed vertically and in accordance with the manufacturer's instructions.

2. Switches shall be accessible for maintenance and calibration.

3. In applications where switches cannot be directly mounted to a tank by the threaded or flanged connection, a mounting bracket shall be provided for connection to the inside tank wall, maintaining the minimum recommended distance from the tank fill opening.

b. Displacement Type Liquid Level Switch

1. Level switches shall be installed in accordance with the manufacturer's instructions.

2. Switches shall be accessible for maintenance and calibration.

3. In applications where switches cannot be directly mounted to a tank by the threaded or flanged connection, a mounting bracket shall be provided for connection to the inside tank wall.

c. Mercury Float Switches

1. Switches shall be mounted in accordance with manufacturer's published instructions. Procedures shall be those used for equipment in hazardous locations.

3.2.15 Pressure Instruments

a. Pressure switches, pressure sensors and transducers shall be verified by calibration.

b. All pressure taps shall incorporate appropriate snubbers.

c. Pressure sensors and pressure switches shall have valves for isolation, venting, and taps for calibration.

d. Pressure switches and pressure transducers installed on liquid or steam lines shall have drains.

e. Pressure transducers, differential pressure sensors and differential pressure switches shall have nulling valves.

f. Switch contact ratings and duty shall be selected for the application.

3.2.16 Temperature Instrument Installation

a. RTD

1. When the RTD is installed in pipe or is susceptible to corrosion or vibration, the RTD shall be installed in a thermowell.

2. Thermowells shall be filled with conductive heat transfer fluid prior to installation of the RTD in the thermowell.

3. RTDs used for space temperature sensing shall include a housing suitable for wall mounting.

4. RTDs used for outside air sensing shall have an instrument shelter or sun shield as shown to minimize solar effects, and shall be mounted to minimize building effects.

5. RTD assemblies shall be readily accessible and installed to allow easy replacement.

b. Temperature Switches

1. Temperature switches shall be installed as specified for RTDs.

2. Temperature switches shall be adjusted to the proper setpoint and shall be verified by calibration.

3. Switch contact ratings and duty shall be selected for the application.

c. Thermometers and Temperature Sensing Elements

1. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.

d. Thermocouples

1. Each thermocouple shall be installed in a protective tube or in a thermowell.

2. Thermocouples shall be insulated from ambient temperature effects.

3. Thermocouple wires shall not be installed in the same conduits as power wiring.

3.2.17 Process Analytical Instrumentation

a. Oxygen and Ozone in Air Monitor

1. The controller shall be mounted in the control panel or as otherwise shown on the drawings.

2. The oxygen sensor shall be located in accordance with the manufacturer's recommendations and as shown on the drawings.

3. High and low alarm settings shall be set as required by the sequence of operation. Settings shall be verified through the use of a manufacturer's standard calibration kit.

b. Total Dissolved Solids

1. The sensor shall be pipe, tank or submersible type as indicated on the drawings.

a) Pipe mounted sensor shall be mounted in a threaded tee or fitting to allow removal of the sensor.

b) Tank mounted sensor shall be mounted in a threaded fitting to allow removal of the sensor.

c) Submersible sensor shall be mounted in an assembly that will allow removal of the sensor from the fluid for replacement.

2. The transmitter and wiring connections shall be located in a weathertight enclosure.

3. The transmitter shall be mounted to allow the digital readout to be easily viewed.

3.2.18 Instrument Shelters

a. Instrument shelters shall be installed in the location shown with the bottom 4.0 feet above the supporting surface using legs and secured rigidly to minimize vibrations from winds.

b. Instrument shelters shall be oriented with door facing North.

c. Instruments located in shelters shall be mounted in the 3-dimensional center of the open space of the shelter.

3.2.19 Output Devices

a. Output devices (transducers, relays, contactors, or other devices) which are not an integral part of the control panel, shall be mounted in an enclosure mounted adjacent to the control panel, unless otherwise shown.

b. Where Hand-Off-Auto (HOA) and/or override switches on the drawings or required by the sequence of operation, the switches shall be installed so that the control system controls the function through the automatic

position and other controls work through the hand position.

3.2.20 Enclosures

All enclosure penetrations shall be from the bottom of the enclosure, and shall be sealed to preclude entry of water using a silicone rubber sealant.

3.3 WIRE, CABLE AND CONNECTING HARDWARE

3.3.1 LAN Cables and Connecting Hardware

LAN cables and connecting hardware shall be installed in accordance with Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

3.3.2 Metering and Sensor Wiring

a. Metering and sensor wiring shall be installed in accordance with the requirements of NFPA 70, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

b. Control panels shall be protected from power line surges. Protection shall meet the requirements of IEEE C62.41.1 and IEEE C62.41.2. Fuses shall not be used for surge protection.

3.3.3 Sensor and Control Wiring Surge Protection

a. Digital and analog inputs shall be protected against surges induced on control and sensor wiring.

b. Digital and analog outputs shall be protected against surges induced on control and sensor wiring installed outdoors and as shown.

c. Fuses shall not be used for surge protection.

3.4 SOFTWARE INSTALLATION

Load software required for an operational control system, including databases, operational parameters, and system, command, and application programs.

Adjust, tune, debug, and commission all software and parameters for controlled systems to assure proper operation in accordance with the sequence of operation.

3.5 CONTROL DRAWINGS

Control drawings, with corresponding CAD files, shall be provided for equipment furnished and for interfaces to equipment at each respective equipment location.

Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation and procedures for safely starting and stopping the system manually shall be provided in Microsoft Word™ format.

Diagrams and instructions shall be submitted prior to posting and the instructions shall be posted before acceptance testing of the system.

3.6 FIELD TESTING AND ADJUSTING EQUIPMENT

Provide personnel, equipment, instrumentation, and supplies necessary to perform site testing.

The Government shall be notified in time to witness the testing, and written permission shall be obtained from the Government before proceeding with the testing.

Original copies of data produced, including results of each test procedure, shall be turned over to the Government at the conclusion of each phase of testing prior to Government approval of the test. Test data shall be provided electronically in PDF format. The test procedures shall cover actual equipment and functions specified for the project.

3.7 TESTING, ADJUSTING AND COMMISSIONING

a. After successful completion of the factory test as specified, the Contractor will be authorized to proceed with the installation of the system equipment, hardware, and software.

b. Once the installation has been completed, test, adjust, and commission each control loop and system in accordance with NIST SP 250 and verify proper operation of each item in the sequence of operation, including hardware and software.

c. Calibrate field equipment, including control devices, adjust control parameters and logic (virtual) points including control loop setpoints, gain constants, constraints, and verify data communications before the system is placed online.

d. Test installed ground rods as specified in IEEE 142.

e. Calibrate each instrumentation device connected to the control system control network by making a comparison between the reading at the device and the display at the workstation, using a standard at least twice as accurate as the device to be calibrated.

f. Check each control point within the control system control network by making a comparison between the control command at the operator workstation and field-controlled device.

g. Deliver trend logs/graphs of all points showing to the Government that stable control has been achieved.

    1. Points on common systems shall be trended simultaneously. One log shall be provided showing concurrent samples taken once a minute for a total of 4 hours.

    2. One log shall be provided showing concurrent samples taken once every 30 minutes, for a total of 24 hours.

    3. Verify operation of systems in the specified failure modes:

        (a) Upon Control system network failure

        (b) Recovery from a loss of power

    3. Verify that systems return to control system control automatically

upon:

(a) a resumption of control system network operation or

(b) A return of power

4. Deliver a report describing results of functional tests, diagnostics, calibrations, and commissioning procedures including written certification to the Government that the installed complete system has been calibrated, tested, adjusted and commissioned and is ready to begin the Performance Verification Test (PVT). The report shall also include a copy of the approved PVT procedure.

3.7.1 Performance Verification Test (PVT)

a. Prepare test procedures for the PVT. The test procedure shall describe all tests to be performed and other pertinent information such as specialized test equipment required and the length of the PVT.

b. The test procedures shall explain, in detail, step-by-step actions and the expected results, to demonstrate compliance with all the requirements of the drawings and this specification.

c. The test procedure shall be site specific and based on the inputs and outputs, required calculated points and the sequence of operation.

d. Demonstrate that the completed Control system complies with the contract requirements.

e. All physical and functional requirements of the project including communication requirements shall be demonstrated and shown.

f. Demonstrate that each system operates as required in the sequence of operation.

g. The PVT as specified shall not be started until after receipt by the Contractor of written permission by the Government, based on the Contractor's written report including certification of successful completion of testing, adjusting and commissioning as specified, and upon successful completion of training as specified.

h. Upon successful completion of the PVT, deliver test reports and other documentation as specified, in PDF format, to the Government.

3.7.2 Endurance Test

a. General

1. Use the endurance test to demonstrate the overall system reliability of the completed system. The endurance test shall be conducted in phases.

2. The endurance test shall not be started until the Government notifies the Contractor in writing that the PVT is satisfactorily completed, training as specified has been completed, outstanding deficiencies have been satisfactorily corrected, and that the Contractor has permission to start the endurance test.

3. Provide an operator to man the system 8 hours per day during daytime operations, including weekends and holidays, during Phase I endurance testing, in addition to any Government personnel that may be made available.

4. The Government may terminate testing at any time when the system fails to perform as specified.

5. Upon termination of testing by the Government or by the Contractor, commence an assessment period as described for Phase II. Upon successful completion of the endurance test, deliver test reports and other documentation, in PDF format, to the Government prior to acceptance of the system.

b. Phase I (Testing)

1. The test shall be conducted 24 hours per day, 7 days per week, for 7 consecutive calendar days, including holidays, and the system shall operate as specified. Make no repairs during this phase of testing unless authorized by the Government in writing.

c. Phase II (Assessment)

1. After the conclusion of Phase I, identify failures, determine causes of failures, repair failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed.

2. After delivering the written report, convene a test review meeting at the job site to present the results and recommendations to the Government. The meeting shall not be scheduled earlier than 5 business days after receipt of the report by the Government. As a part of this test review meeting, demonstrate that failures have been corrected by performing appropriate portions of the performance verification test. The Government reserves the right to cancel the test review meeting if no failures or deficiencies occur during the Phase I testing. If the Government chooses to do so, the Contractor will be notified in writing.

3. Based on the Contractor's report and the test review meeting, the Government will determine if retesting is necessary and the restart point. The Government reserves the right to require that the Phase I test be totally or partially rerun. Do not commence any required retesting until after receipt of written notification by the Government. After the conclusion of any retesting which the Government may require, the Phase II assessment shall be repeated as if Phase I had just been completed.

3.8 EXCLUSIONS

The Contractor will not be held responsible for failures resulting from the following:

a. Outage of the main power supply in excess of the capability of any backup power source, provided that the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the control system performed as specified.

b. Failure of a Government furnished communications link, provided that the PLC automatically and correctly operates in the stand-alone mode as specified, and that the failure was not due to Contractor furnished equipment, installation, or software.

c. Failure of existing Government owned equipment, provided that the failure was not due to Contractor furnished equipment, installation, or software.

3.9 MANUFACTURERS' FIELD SERVICES

Obtain the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment specified. The representative shall supervise the installing, adjusting, and testing of the equipment.

3.10 FIELD TRAINING

Field training oriented to the specific system shall be provided for designated personnel.

a. A copy of the training manual for each trainee plus two additional copies shall be delivered to the COR. The training manual shall also be provided electronically in PDF format.

b. Manuals shall include an agenda, the defined objectives for each lesson, and a detailed description of the subject matter for each lesson.

c. Furnish audiovisual equipment and other training supplies and materials. Copies of the audiovisuals shall be delivered with the printed training manuals.

d. The Government reserves the right to record training sessions for later use.

e. A training day is defined as 8 hours of classroom instruction, excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility.

f. Approval of the Contractor's training schedule shall be obtained from the Government at least 30 days before the training.

3.10.1 Preliminary Operator Training

a. Prior to the start of field testing, preliminary operator training shall be taught at the project site for three consecutive training days.

b. Upon completion of this course, each student, using appropriate documentation, should be able to perform elementary operations with guidance and describe the general hardware architecture and functionality of the system.

c. This course shall include:

1. general system architecture;

2. functional operation of the system, including workstations;

3. operator commands;

4. application programs, control sequences, and control loops; database entry and modification;

5. reports generation, alarm reporting, and historical files;

6. diagnostics and troubleshooting.

3.10.2 Additional Operator Training

a. Following the field testing, additional classroom training for operators shall be taught for five consecutive training days;

b. Individual instruction shall consist of "hands-on" training under the constant monitoring of the instructor.

c. Classroom training shall include instruction on the specific hardware configuration of the installed control system and specific instructions for operating the installed system.

d. Schedule activities during this period so that the specified amount of time on the equipment will be available for each student.

e. The final session will address specific topics that the students need to discuss and to answer questions concerning the operation of the system.

f. Upon completion of the course, the students should be fully proficient in system operation and have no unanswered questions regarding operation of the installed control system. Each student should be able to start the system, operate the system, recover the system after a failure and describe the specific hardware architecture and operation of the system and be fully proficient in all system operations.

g. Report the skill level of each student at the end of this course.

3.10.3 Maintenance Training

a. Following the endurance test, a minimum period of five training days shall be provided by a factory representative or a qualified Contractor trainer for up to ten designated personnel on maintenance of the equipment.

b. The training shall include:

1. physical layout of each piece of hardware,

2. calibration procedures,

3. preventive maintenance procedures,

4. schedules,

5. troubleshooting, diagnostic procedures and repair instructions.

3.10.4 Specialized Training

Following the maintenance training, a minimum period of one training day shall be provided by a factory representative or a qualified Contractor trainer for up to ten people on each type of specialized equipment to include calibration, maintenance and testing of sensing elements and transducers.

-- End of Section --

Appendix A

SVS BOILER REPLACEMENT SEQUENCE OF OPERATION

SVS BOILER REPLACEMENT SEQUENCE OF OPERATION

A) GENERAL PLANT

1) SEQUENCE DESCRIBES AUTOMATIC OPERATION, EXCEPT WHERE NOTED THAT AUTOMATIC OPERATION IS DISABLED.

2) NORMAL SVS OPERATION REQUIRES ANY TWO BOILERS TO BE COMMANDED TO START (SEE BOILER SEQUENCE). TWO BOILERS ARE DESIGNED TO PROVIDE 100% OF THE PLANT CAPACITY, WHILE THIRD BOILER IS RESERVED FOR STANDBY DUTY.

3) CONTROL SET POINTS: SET POINTS, HIGH LIMITS, AND LOW LIMITS SHALL BE PROGRAMMABLE BY CONTROL SYSTEM. PROGRAM SET POINTS, CONTROL RANGE, AND FEEDBACK BIAS FOR STABLE OPERATION AND PREVENTION OF EQUIPMENT SHORT CYCLING.

4) EQUIPMENT ENABLE: PLANT OPERATION WILL BE ENABLED MANUALLY, AND LOCKED OUT FOR OVERNIGHT SHUTDOWN, EXCEPT AS REQUIRED FOR AUXILIARY HEATING.

5) EQUIPMENT MONITORING: MONITOR EQUIPMENT STATUS, AS NOTED IN SEQUENCE, UNLESS LOCKED OUT FOR SERVICE. DETERMINE FAN STATUS BY CURRENT SWITCH. DETERMINE PUMP STATUS BY PRESSURE DIFFERENTIAL OR FLOW SWITCH. DETERMINE EQUIPMENT STATUS FROM UNIT SUMMARY ALARM. REFER TO SYSTEM SEQUENCES FOR ADDITIONAL PARAMETERS TO MONITOR.

6) EQUIPMENT FAILURE: UNLESS OTHERWISE NOTED, STOP FAILED EQUIPMENT, CLOSE ISOLATION VALVES AND STOP ANY DEDICATED PUMP ASSOCIATED WITH FAILED EQUIPMENT. REFER TO DEVICE SEQUENCES FOR FAILURE CONDITION.

7) ALARMS AND NOTIFICATION: ALARM LOCALLY AND REMOTELY WHEN ANY ALARM CONDITION EXISTS, AS NOTED IN SEQUENCE OF OPERATION. ALARM VISUALLY AND AUDIBLY, UNLESS OTHERWISE NOTED. IDENTIFY SPECIFIC UNIT OR DEVICE THAT FAILED. ALARM WHEN ANY HIGH OR LOW LIMIT SET POINT IS EXCEEDED. MAINTAIN RECORD OF ALARM CONDITIONS.

8) LOCAL INSTRUMENTATION: REFER TO INSTRUMENTATION AND CONTROLS DRAWINGS AND SPECIFICATIONS.

9) REMOTE INSTRUMENTATION: REFER TO INSTRUMENTATION AND CONTROLS DRAWINGS AND SPECIFICATIONS.

10) PIPING AND INSTRUMENTATION DIAGRAMS (P&IDs): THESE DRAWINGS ARE SCHEMATIC REPRESENTATIONS INTENDED TO SHOW THE BASIC CONFIGURATION. ALL ADDITIONAL CONTROL ITEMS NECESSARY TO MEET THE FUNCTIONAL REQUIREMENTS OF THE SEQUENCE OF OPERATION AND SPECIFICATIONS SHALL BE PROVIDED. PROVIDE A COMPLETE SYSTEM WHICH IS FUNCTIONAL IN ALL RESPECTS.

11) INTERLOCKS: INTERLOCKS DESCRIBED IN THIS SEQUENCE APPEAR ON THE P&IDS AND ARE SUMMARIZED IN TABLE A-1. PROVIDE A COMPLETE SYSTEM, INCLUDING ALL NECESSARY INTERLOCKS, WHICH IS FUNCTIONAL IN ALL RESPECTS.

B) FEEDWATER SYSTEM

1) GENERAL: 100% PLANT CAPACITY REQUIRES TWO OPERATING FEEDWATER PUMPS (BFP-1,2,3), TO OPERATE WITH TWO OPERATING BOILERS, WHILE THIRD PUMP IS RESERVED FOR STANDBY DUTY.

2) PUMP OPERATION: START LEAD PUMP WHEN ANY BOILER IS COMMANDED TO START. START LAG PUMP WHEN SECOND BOILER IS COMMANDED TO START. STOP PUMPS IN REVERSE SEQUENCE AS BOILERS ARE COMMANDED TO STOP, AND AFTER BURNER FUEL GAS PURGE CYCLE IS COMPLETE.

3) PUMP MANUAL OPERATION: START AND STOP EACH PUMP REMOTELY WHEN AUTOMATIC OPERATION IS DISABLED. PROVIDE MANUAL HOA SWITCH ON EACH PUMP CONTROLLER TO MANUALLY START AND STOP PUMP LOCALLY.

4) PUMP SEQUENCING: ON A REGULAR BASIS, AUTOMATICALLY ALTERNATE LEAD, LAG AND STANDBY PUMP TO EQUALIZE RUN TIME FOR EACH PUMP. ANY PUMP CAN BE DESIGNATED AS THE LEAD, LAG OR STANDBY PUMP.

5) PUMP SPEED: MODULATE PUMP SPEED TO MAINTAIN CONSTANT OPERATING PRESSURE DIFFERENTIAL SET POINT BETWEEN BOILER STEAM PRESSURE AND INLET PRESSURE TO BOILER DRUM LEVEL CONTROL VALVE ASSEMBLY. PRESSURE DIFFERENTIAL SET POINT SHALL BE DETERMINED BY BALANCING AGENCY AT DESIGN WATER FLOW. RAMP UP PUMP SPEED DURING PUMP START UP UNTIL COMMANDED SPEED IS ATTAINED. OPERATE BOTH PUMPS AT SAME SPEED WHEN TWO PUMPS ARE OPERATING AFTER INITIAL RAMP UP.

6) MINIMUM FLOW CONTROL: MODULATE RECIRCULATION FLOW CONTROL VALVE (FCV-4312, FCV-4342 OR FCV-4372) TO MAINTAIN MINIMUM REQUIRED PUMP FLOW FOR EACH PUMP AS SENSED BY FLOW ELEMENT ON SUCTION OF EACH BFP. VERIFY MINIMUM FLOW SET POINT (LISTED ON PUMP SCHEDULE) WITH PUMP MANUFACTURER. CLOSE RECIRCULATION VALVE WHEN FLOW EXCEEDS MINIMUM FLOW.

7) PUMP FAILURE: PUMP FAILURE OCCURS WHEN PUMP FAILS TO START OR TO CONTINUE OPERATING WHEN COMMANDED AFTER ALLOWING SUFFICIENT TIME FOR START SEQUENCE TO COMPLETE. PUMP FAILURE ALSO OCCURS WHEN PUMP MINIMUM FLOW CANNOT BE MAINTAINED. STOP FAILED PUMP AND START STANDBY PUMP WHEN LEAD OR LAG PUMP FAILS. START STANDBY PUMP WHEN LEAD AND LAG PUMPS FAIL TO MAINTAIN PRESSURE DIFFERENTIAL BETWEEN PIPE HEADER AND BOILER. INITIATE BOILER SHUTDOWN SEQUENCE IF STANDBY PUMP FAILS.

8) EQUIPMENT MONITORING: MONITOR THE FOLLOWING:
   - PUMP BEARING TEMPERATURE: ALARM HIGH TEMPERATURE. TREND TEMPERATURE.
   - PUMP VIBRATION LEVEL: ALARM EXCESSIVE VIBRATION. TREND VIBRATION LEVEL.
   - PUMP FLOW: ALARM LOW FLOW OR HIGH FLOW
   - PUMP MOTOR CURRENT: ALARM HIGH CURRENT OR NO CURRENT WHEN PUMP IS COMMANDED TO OPERATE.
   - ISOLATION VALVE POSITION: ALARM VALVE (V-4300, V-4330 AND V-4360) CLOSED POSITION WHEN ASSOCIATED EQUIPMENT IS COMMANDED TO OPERATE.
   - PUMP PRESSURE DIFFERENTIAL (SEE SPEED CONTROL). ALARM LOW OR HIGH DIFFERENTIAL.
   - BOILER DRUM LEVEL: ALARM LOW OR HIGH WATER LEVEL.

C) DEAREATOR HEATER / FEEDWATER TANK

1) OPERATING LEVEL CONTROL: MODULATE CONTROL VALVE (LCV-4230) TO MAINTAIN CONSTANT WATER LEVEL AT 75% OF TANK DEPTH, AS SENSED BY LEVEL TRANSMITTER LT-4230. ALARM WHEN WATER LEVEL DROPS TO 55% OF TANK DEPTH. INITIATE BOILER SHUTDOWN SEQUENCE AND TRIP BOILER FEED PUMPS AFTER A TIME DELAY, TO ENSURE FUEL SUPPLY CUT-OFF, WHEN WATER LEVEL DROPS TO 20% OF TANK DEPTH.

2) OVERFLOW CONTROL: MODULATE OVERFLOW LEVEL CONTROL VALVE (LCV-4237) TO PREVENT WATER LEVEL FROM EXCEEDING HIGH LEVEL LIMIT. ALARM WHEN WATER RISES TO WITHIN 2” OF HIGH LEVEL LIMIT.

3) PRESSURE CONTROL: MODULATE PRESSURE CONTROL VALVES PCV-5830 (FROM MAIN STEAM HEADER) AND PCV-5642 (FROM AUXILIARY BOILER) TO MAINTAIN CONSTANT STEAM PRESSURE SET POINT (ADJUSTABLE), AS SENSED BY PRESSURE TRANSMITTER PT-4207 IN DEAERATOR TANK VESSEL.

4) SYSTEM MONITORING: MONITOR THE FOLLOWING:
   - DEAERATOR PRESSURE: INDICATE LOCALLY AND REMOTELY AND TREND. ALARM LOW & HIGH PRESSURE.
   - FEEDWATER TANK PRESSURE: INDICATE LOCALLY.
   - WATER LEVEL: INDICATE LOCALLY AND REMOTELY AND TREND. ALARM LOW, LOW-LOW, HIGH AND HIGH-HIGH.

D) SCW SYSTEM

1) WATER SOFTENING SYSTEM: OPEN MOTOR OPERATED VALVE (CV-4122), AND ENABLE SOFTENER SYSTEM CONTROLS. MAINTAIN OUTLET WATER QUALITY SET POINTS PER SPECIFICATION USING INTEGRAL WATER SOFTENING SYSTEM CONTROLS.

2) HOT WELL HEAT RECOVERY PUMP (HXP-1): INTERLOCK TO ENABLE PUMP OPERATION ONLY WHEN EXISTING HOT WELL PUMP (P-3) IS OPERATING. START PUMP WHEN FEEDWATER FLOW IS DETECTED BY FLOW SWITCH FS-4123. MODULATE PUMP SPEED FROM 30% TO 100% AS MEASURED SCW FLOW VARIES FROM 5% TO 75% OF DESIGN FLOW. MONITOR PUMP STATUS, AND ALARM IF PUMP FAILS WHEN COMMANDED TO OPERATE.

3) CONTINUOUS BLOWDOWN HEAT RECOVERY PUMPS (HXP-2 AND HXP-3): INTERLOCK TO ENABLE BOTH PUMPS TO OPERATE ONLY WHEN ANY AUTOMATIC CONTINUOUS BLOWDOWN VALVE IS OPEN (CV-5700, CV-5703 OR CV-5706). START PUMPS HXP-2 AND HXP-3 WHEN FEEDWATER FLOW IS DETECTED BY FLOW SWITCH FS-4123. MONITOR EACH PUMP STATUS, AND ALARM IF PUMP FAILS WHEN COMMANDED TO OPERATE.

4) EQUIPMENT MONITORING: MONITOR THE FOLLOWING:
   - SYSTEM STATUS: SUMMARY ALARM UPON FAILURE.
   - PUMP MOTOR CURRENT: ALARM HIGH CURRENT OR NO CURRENT WHEN PUMP IS COMMANDED TO OPERATE.
   - PUMP FLOW: ALARM NO FLOW WHEN PUMP IS COMMANDED TO OPERATE.

E) DRUM LEVEL

1) DRUM LEVEL CONTROL: PROVIDE THREE-ELEMENT FEEDWATER CONTROL SYSTEM TO MAINTAIN NORMAL DRUM WATER LEVEL BASED ON THESE INDEPENDENT VARIABLES: STEAM FLOW, FEEDWATER FLOW, AND DRUM LEVEL.

2) MODULATE FEEDWATER CONTROL VALVE TO MATCH FEEDWATER MASS FLOW RATE TO THE STEAM FLOW RATE FROM RESPECTIVE BOILER. BIAS FEEDWATER CONTROL VALVE SIGNAL TO INCREASE FEEDWATER FLOW WHEN DRUM LEVEL IS BELOW NORMAL SET POINT.

3) EQUIPMENT MONITORING: MONITOR THE FOLLOWING:
   - DRUM LEVEL: INDICATE LOCALLY AND REMOTELY, AND TREND. ALARM LOW, LOW-LOW, HIGH AND HIGH-HIGH.
   - DRUM PRESSURE: INDICATE LOCALLY AND REMOTELY. ALARM LOW, HIGH, HIGH-HIGH.
   - FEEDWATER FLOW TO DRUM: INDICATE REMOTELY, TREND AND TOTALIZE.

     STEAM FLOW: INDICATE REMOTELY, TREND AND TOTALIZE.

F) BURNER MANAGEMENT SYSTEM (BMS)

1) FUNCTION: MAINTAIN COMBUSTION SAFETY THROUGH DEDICATED BMS. BMS SHALL CONTROL THE SEQUENCING OF BURNER PRE-PURGE, LIGHT OFF, AND SHUTDOWN CYCLES; AND, SUPERVISE ALL BURNER SAFETY SHUTDOWN FUNCTIONS, INCLUDING FLAME MONITORING AND TRIPPING. DESIGN BMS TO MEET NFPA 85. BMS SHALL BE APPROVED BY THE BOILER MANUFACTURER.

G) BOILER COMBUSTION

1) CONTROL FUNCTIONS: MAXIMIZE COMBUSTION EFFICIENCY OF BURNERS BASED ON THESE INDEPENDENT VARIABLES: FUEL FLOW RATE, COMBUSTION AIR FLOW RATE, AND STACK OXYGEN CONCENTRATION.

2) FUEL FLOW: MODULATE FUEL FLOW CONTROL VALVE IN RESPONSE TO PLANT MASTER DEMAND SIGNAL.

3) COMBUSTION AIR FLOW: MODULATE FORCED DRAFT FAN SPEED TO CONTROL COMBUSTION AIR FLOW TO PROPORTIONAL SET POINT WITH FUEL FLOW. OPTIMIZE BURNER FUEL/AIR RATIO BY AUTOMATICALLY ADJUSTING PROPORTIONAL SET POINT ACCORDING TO STACK OXYGEN LEVEL.

4) CROSS LIMITING CONTROL: FUEL FLOW CONTROLS SHALL BE CROSS LIMITED WITH AIR FLOW CONTROLS SUCH THAT AIR LEADS FUEL ON FIRING RATE INCREASE AND FUELS LEADS AIR ON FIRING RATE DECREASE.

5) CONTROLLER DISPLAYS:
   - DRUM STEAM PRESSURE, AND SET POINT
   - FIRING RATE
   - STEAM FLOW
   - COMBUSTION AIR FLOW SET POINT
   - % O2 LEVEL, AND SET POINT
   - %TRIM

H) BOILER PLANT MASTER CONTROLS

1) PLANT INTERFACE: INTERFACE ALL THREE BOILER CONTROLLERS WITH BOILER PLANT MASTER CONTROLLER.

2) PLANT STARTUP: MANUALLY START AND SHUTDOWN BOILER PLANT REMOTELY.

3) A BOILER SHALL NOT BE CAPABLE OF BEING CONTROLLED FROM A FIELD PANEL AND THE CONTROL ROOM AT THE SAME TIME. IF A FIELD PANEL IS TO BE USED TO OPERATE THE BOILER DURING TESTING, MAINTENANCE OR OFF-NORMAL CONDITIONS, THE CONTROL ROOM SHALL RELINQUISH CONTROL TO THE FIELD PANEL.

4) EQUIPMENT ALTERNATION: ROTATE LEAD, LAG AND STANDBY BOILERS MONTHLY. ROTATE LEAD, LAG AND STANDBY BOILER FEEDWATER PUMPS MONTHLY (ADJUSTABLE).

5) PLANT CAPACITY: ESTABLISH FIRING RATE DEMAND TO MAINTAIN SVS STEAM HEADER PRESSURE. ANTICIPATE CHANGE IN STEAM PRESSURE BASED ON CHANGE RATE OF TOTAL PLANT STEAM FLOW.

6) EMERGENCY SHUTDOWN: AUTOMATICALLY SHUT DOWN ALL PLANT EQUIPMENT AFTER ANY BMS BOILER SHUTDOWN SEQUENCE HAS BEEN COMPLETED.

I) NOX CONTROLS

1) NOX CONTROL: CONTROL NOX WITH SCR AND AMMONIA INJECTION TO MEET REGULATORY LIMITS. INJECT AMMONIA INTO BREECHING OF OPERATING BOILERS ONLY.

2) AMMONIA: MODULATE AMMONIA FLOW RATE IN PROPORTION TO BURNER FIRING RATE. ADJUST INJECTION RATE CONTROL SIGNAL BASED ON NOX LEVEL IN STACK. MAINTAIN SOURCE MANIFOLD PRESSURE SET POINT WITH PRESSURE REDUCING VALVES. MIX WITH DILUTION AIR.

3) DILUTION AIR: START AND OPERATE BOILER DILUTION AIR BLOWERS WHEN RESPECTIVE GAS VALVE OPENS. MIX AND DILUTE ANHYDROUS AMMONIA PRIOR TO INJECTION INTO FLUE GAS STREAM. INJECT DILUTE AMMONIA MIXTURE UPSTREAM OF SCR CATALYST.

4) SCR: MONITOR PRESSURE DROP ACROSS SCR BANK. ALARM HIGH LIMIT.

J) SVS STEAM SUPPLY PRESSURE

1) PRESSURE CONTROL: MODULATE PRESSURE CONTROL VALVE PCV-5807 TO MAINTAIN CONSTANT STEAM PRESSURE SET POINT.

2) INTERLOCK PRESSURE CONTROL VALVE PCV-5808 IN THE OPENED POSITION WHEN EITHER OF THE NORTH OR SOUTH PLENUM KIRK INTERLOCK KEYS ARE REMOVED FROM THEIR KEY SLOTS.

K) BLOWDOWN SYSTEM

1) TDS CONTROL: MODULATE BOILER CONTINUOUS BLOWDOWN VALVE (CV-5700, CV-5703 AND CV-5706) TO MAINTAIN RESPECTIVE BOILER WATER TDS CONCENTRATION BELOW MAXIMUM SETPOINT (ADJUSTABLE). CONTINUOUSLY MEASURE TDS CONCENTRATION USING CONDUCTIVITY SENSOR (CE-5700, CE-5703 AND CE-5706). CONTROL EACH BOILER INDIVIDUALLY.

2) FLASH VESSEL LEVEL: MODULATE LEVEL CONTROL VALVE (LCV-5710) TO MAINTAIN CONSTANT WATER LEVEL IN CONTINUOUS BLOWDOWN FLASH VESSEL.

3) CONTINUOUS BLOWDOWN HEAT RECOVERY: REFER TO SCW SEQUENCE OF OPERATION.

4) INTERMITTENT BLOWDOWN: OPEN AND CLOSE MANUAL VALVES AT MUD DRUM AT START OF EACH BOILER SHIFT FOR TIMED DURATION TO CLEAR SLUDGE WITH MINIMAL WATER LOSS.

5) DISCHARGE TEMPERATURE: MODULATE SELF-REGULATING CONTROL VALVE (TCV-5743) TO MIX COLD WATER WITH DISCHARGE FROM INTERMITENT BLOWDOWN TANK TO MAINTAIN MIXED TEMPERATURE BELOW MAXIMUM SET POINT OF 120°F.

L) CHEMICAL FEED SYSTEM

1) OPERATION: INTERLOCK CHEMICAL FEED PUMPS TO START, OR INITIATE AUTOMATIC CHEMICAL INJECTION CYCLE WHEN ANY BOILER FEEDWATER PUMP STARTS.
   - FOR VARIABLE SPEED CHEMICAL FEED PUMPS, VARY PUMP SPEEDS TO ADJUST CHEMICAL INJECTION RATE IN PROPORTION WITH FEEDWATER FLOW RATE.
   - FOR FIXED SPEED PUMPS, VARY DURATION PUMPS ARE ON WHEN A PRE-SET NUMBER OF FEEDWATER GALLONS IS REACHED.

2) BOILERS: ENABLE THE FOLLOWING CHEMICAL ADDITION SOLENOID VALVES TO OPEN ONLY WHEN ASSOCIATED BOILER PAIR IS COMMANDED TO OPERATE BY PLANT MASTER CONTROLLER, AND ASSOCIATED BOILER FEEDWATER VALVE (LCV-5005, LCV-5205, LCV-5405) IS OPEN:
   - BOILERS 1 & 2 OPERATING: ONLY VALVES SOV-4480, 4482, 4484, 4486 OPEN
   - BOILERS 1 & 3 OPERATING: ONLY VALVES SOV-4480, 4483, 4484, 4487 OPEN
   - BOILERS 2 & 3 OPERATING: ONLY VALVES SOV-4481, 4483, 4485, 4487 OPEN

3) FLOW RATE: RESET CHEMICAL FEED RATES BASED ON BOILER WATER ANALYSIS.
   - FOR VARIABLE SPEED PUMPS, ADJUST CHEMICAL FEED RATES BY SETTING AND ADJUSTING PUMP SPEED SETPOINTS.
   - FOR FIXED SPEED PUMPS, ADJUST CHEMICAL FEED RATES BY
     a) ADJUSTING SETPOINTS FOR THE NUMBER OF FEEDWATER GALLONS FOR EACH INJECTION CYCLE THAT ACTIVATES THE CHEMICAL FEED PUMPS, AND BY
     b) ADJUSTING THE SETPOINTS FOR THE DURATIONS THAT THE PUMPS REMAIN ON.

M) AUXILIARY FEEDWATER HEATING SYSTEM

1) GENERAL: AUXILIARY STEAM BOILER SB-4 PROVIDES STEAM TO FEEDWATER TANK TO OFFSET HEAT LOSSES IN FEEDWATER TANK WHEN THE MAIN BOILERS ARE NOT OPERATING. AUXILIARY BOILER SUPPLIES PRESSURIZED STEAM TO BLANKET THE FEEDWATER FREE SURFACE.

2) AUXLIARY HEATING SYSTEM: ENABLE AND DISABLE SYSTEM MANUALLY FOR AUTOMATIC OPERATION OVERNIGHT AND WEEKEND OPERATION. AUTOMATICALLY DISABLE ENTIRE SYSTEM UPON ANY ALARM CONDITION.

3) BOILER: AUTOMATICALLY STAGE BURNER OPERATION TO MAINTAIN STEAM PRESSURE WITHIN SET POINT RANGE (12 PSIG, ADJUSTABLE) BY UNIT COMBUSTION CONTROLLER. AUTOMATICALLY MAINTAIN STEAM DRUM WATER LEVEL BY UNIT CONTROLLER. AUTOMATICALLY MANAGE BURNER FOR SAFE OPERATION.

4) FEEDWATER PUMP: OPEN FEEDWATER VALVE WHEN BOILER WATER LEVEL IS BELOW LOWER SET POINT. INTERLOCK PUMP TO START WHEN FEEDWATER VALVE IS OPEN. STOP PUMP AND CLOSE FEEDWATER VALVE WHEN BOILER WATER LEVEL IS ABOVE UPPER SET POINT.

5) BOILER SAFETIES: CLOSE GAS VALVE TO BURNER WHEN WATER LEVEL DROPS BELOW SAFE OPERATING LEVEL. PROVIDE AUXILIARY LOW WATER CUTOFF WHEN WATER LEVEL DROPS FURTHER BELOW THE MECHANICAL LOW WATER CUTOFF. CLOSE GAS VALVE TO BURNER UPON NON-IGNITION OR UNSAFE FLAME CONDITION. CLOSE GAS VALVE TO BURNER WHEN STEAM PRESSURE EXCEEDS HIGH PRESSURE LIMIT. PREVENT OVERPRESSURE WITH SAFETY RELIEF VALVE.

6) DEAERATOR VENT: AUTOMATICALLY CLOSE VENT VALVE SOV-4208 WHEN GAS VALVES TO ALL HIGH PRESSURE BOILERS (SB-1, SB-2, SB-3) ARE CLOSED.

7) STEAM PRESSURE: MAINTAIN DEAERATOR STEAM PRESSURE SET POINT (7 PSIG, ADJUSTABLE) WITH PRESSURE REDUCING VALVE.

N) ANHYDROUS AMMONIA SYSTEM

1) AN AMMONIA DELIVERY SYSTEM, CONSISTING OF AN AMMONIA STORAGE TANK AND AN AMMONIA DIFFUSION TANK, WILL PROVIDE THE REQUIRED AMMONIA TO THE THREE BOILERS FLUE GAS STACK VENTILATION SYSTEMS. THE SYSTEM SEQUENCE OF OPERATIONS IS DESCRIBED IN THE MECHANICAL GENERAL NOTES, DRAWING A231-1300-M002.

2) A LOCAL PRESSURE GAUGE AND SWITCH ON THE RELIEF VALVE DISCHARGE PIPE PROVIDES INDICATION THAT AN OVER-PRESSURE EVENT HAS OCCURRED. THE HIGH PRESSURE ALARM FROM THE SWITCH IS LATCHED TO REQUIRE OPERATOR ACTION.

3) MANUAL EMERGENCY BUTTONS WILL BE AVAILABLE IN THE CONTROL ROOM, AND IN AND AROUND THE BOILER PLANT AREA TO PROVIDE A WARNING OF A DETECTABLE AMMONIA LEAK, AND TO ISOLATE THE AMMONIA TANK. PUSHING ANY OF THE EMERGENCY BUTTONS CLOSES THE AMMONIA TANK EMERGENCY SHUTOFF VALVE, AND TRIGGERS AUDIBLE AND VISUAL ALARMS.

Table A-1. SVS Boiler Replacement - Interlocks

Interlock Number	Interlock Source			Interlock Action		
	Instrument or Equipment	Description	Reference Drawing	Equipment	Description	Reference Drawing
I-1 (hard-wired)	P-3	SVS Hot Well Pump	A234A-0900-J0001	HXP-1	Hot Well Pump P-3 STOPPED prevents Hot Well Heat Recovery Pump HXP-1 from running.	A331-1300-J701
I-2	LALL-4230	Feedwater Tank Low-Low Alarm Level	A331-1300-J702	Boiler; BFP-1, BFP-2, BFP-3	Low-Low Feedwater Tank Level shuts down boiler, and Stops all boiler feedwater pumps after a set time delay.	A331-1300-J706
I-3 (hard-wired)	LSLL-4234	Feedwater Tank Low-Low Level Switch	A331-1300-J702	Boiler; BFP-1, BFP-2, BFP-3	Low-Low Feedwater Tank Level shuts down boiler, and Stops all boiler feedwater pumps after a set time delay.	A331-1300-J706
I-4	CV-5700; CV-5703; CV-5706	Continuous Blowdown Valves	A331-1300-J709, J711, J713	HXP-2 and HXP-3	All Continuous Blowdown Valves CLOSED prevents Blowdown Heat Recovery Pumps HXP-2 and HPX-3 from running. (Any Continuous Blowdown Valve OPENED enables both pumps to operate.)	A331-1300-J704
I-5	BFP-1; BFP-2; BFP-3	Boiler Feedwater Pumps	A331-1300-J706	CFP-1, CFP-2A,-2B, CFP-3A,-3B, CFP-4A,-4B	RUNNING any feedwater pump enables all Chemical Feed Pumps CFP-1, CFP-2A, CFP-2B, CFP-3A, CFP-3B, CFP-4A, CFP-4B, to operate.	A331-1300-J703
I-6	Master Controller LCV-5005	Command to operate Boiler 1; Boiler 1 Feedwater Valve	A331-1300-J708	V-4480, V-4484	Command to operate Boiler 1 by Master Controller and Boiler 1 feedwater valve OPENED opens the Chemical Feed solenoid valves V-4480 and V-4484 to Boiler 1 steam drum.	A331-1300-J703
I-7	Master Controller LCV-5205	Command to operate Boiler 2; Boiler 2 Feedwater Valve	A331-1300-J710	V-4482, V-4486 or V-4481, V-4485	Command to operate Boiler 2 by Master Controller AND Boiler 2 Feedwater Valve OPENED opens the chemical feed solenoid valves V-4482 and V-4486 (if Boiler 1 also selected) or valves V-4481 and V-4485 (if Boiler 3 also selected) to Boiler 2 steam drum.	A331-1300-J703

Table A-1. SVS Boiler Replacement - Interlocks

Interlock Number	Interlock Source			Interlock Action		
	Instrument or Equipment	Description	Reference Drawing	Equipment	Description	Reference Drawing
I-8	Master Controller LCV-5405	Command to operate Boiler 3; Boiler 3 Feedwater Valve	A331-1300-J712	V-4483, V-4487	Command to operate Boiler 3 by Master Controller and Boiler 3 feedwater valve OPENED opens the Chemical Feed solenoid valves V-4483 and V-4487 to Boiler 3 steam drum.	A331-1300-J703
I-9	ZIO-4300 ZIO-4330 ZIO-4360	Feedwater Pumps Isolation Valves	A331-1300-J706	BFP-1, BFP-2, BFP-3	Feedwater Pumps Isolation Valve must be OPENED to operate its respective Boiler Feedwater Pump.	A331-1300-J706
I-10 (hard-wired)	FS-4123	Feedwater Flow Switch	A331-1300-J701	HXP-1, HXP-2, HXP-3	Flow detected by flow switch FS-4123 starts Heat Exchanger Pumps HXP-1, HXP-2 and HXP-3.	A331-1300-J701 and, J704
I-11 (hard-wired)	Either Kirk Key	North or South Plenum SVS System Kirk Keys	---	PCV-5807; All Boilers	Removing either the North or South Plenum SVS System Kirk Interlock Keys from their key slots opens Pressure Control Valve PCV-5807, and prevents the boilers from being started.	A331-1300-J707
I-12 (hard-wired)	Master Controller	Boiler 1, Boiler 2, Boiler 3	---	SOV-4208	Operation of any boiler (SB-1, SB-2 or SB-3) opens Deaerator Vent Assembly solenoid valve SOV-4208. (Close if all three main boilers off.)	A331-1300-J702
I-13 (hard-wired)	BFP-4	Feedwater Pump to Auxiliary Boiler	A331-1300-J702	SOV-5625	Pump BFP-4 discharge solenoid valve SOV-5625 opens when Pump BFP-4 starts.	A331-1300-J702
I-14 (hard-wired)	HS-6630 HS -6631 HS -6632 HS -6633	NH3 Emergency Buttons	A331-1300-J715	SOV-6609	Pushing any of the NH3 emergency buttons HS-6630, HS-6631, HS-6632 or HS-6633 closes the ammonia tank emergency shutoff solenoid valve SOV-6609, and triggers audible and visual alarms in the boiler plant area and in the control room.	A331-1300-J715

Appendix B

REMOTE I/O INSTRUMENT POINT LIST

Remote I/O Instrument Point List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	P&ID DWG
FI-3005	FI	3005	MPG	Natural Gas Supply Flow Indication	AI	0	10,000	PPH	J714
FQI-3005	FQI	3005	MPG	Natural Gas Supply Flow Totalizer	AI	0	1,000,000	Kilo-Pounds	J714
PI-3010	PI	3010	MPG	Natural Gas Supply Pressure Indication	AI	0	50	psig	J714
PAL-3010	PAL	3010	MPG	Natural Gas Supply Pressure Alarm Low	DI	20	-	psig	J714
FI-3100	FI	3100	G	Natural Gas Supply to Boiler 1 Flow Indication	AI	0	10,000	PPH	J709
FQI-3100	FQI	3100	G	Natural Gas Supply to Boiler 1 Flow Totalizer	AI	0	1,000,000	Kilo-Pounds	J709
FI-3200	FI	3200	G	Natural Gas Supply to Boiler 2 Flow Indication	AI	0	10,000	PPH	J711
FQI-3200	FQI	3200	G	Natural Gas Supply to Boiler 2 Flow Totalizer	AI	0	1,000,000	Kilo-Pounds	J711
FI-3300	FI	3300	G	Natural Gas Supply to Boiler 3 Flow Indication	AI	0	10,000	PPH	J713
FQI-3300	FQI	3300	G	Natural Gas Supply to Boiler 3 Flow Totalizer	AI	0	1,000,000	Kilo-Pounds	J713
FAL-4012	FAL	4012	IW	Boiler FW Pump 1 Cooling Water Flow Alarm Low	DI	-	-	-	J706
FAL-4017	FAL	4017	IW	Boiler FW Pump 2 Cooling Water Flow Alarm Low	DI	-	-	-	J706
FAL-4022	FAL	4022	IW	Boiler FW Pump 3 Cooling Water Flow Alarm Low	DI	-	-	-	J706
PI-4071	PI	4071	MU	Water Softener Inlet Pressure Indication	AI	0	100	psig	J701
PI-4081	PI	4081	SCW	Water Softener Outlet Pressure Indication	AI	0	100	psig	J701
PAL-4081	PAL	4081	SCW	Water Softener Outlet Pressure Alarm Low	CALC	35	-	psig	J701
FI-4082	FI	4082	SCW	Water Softener Outlet Flow Indication (FIC-4082 controls XC-4106)	AI	0	500,000	PPH	J701
FC-4082	FC	4082	BFS	Water Softener Outlet Flow Control Output (FIC-4082 controls XC-4106)	AO	0	100	Percent	J701
FQI-4082	FQI	4082	SCW	Water Softener Outlet Flow Totalizer	AI	0	1,000,000	Kilo-Pounds	J701
FQAH-4082	FQAH	4082	SCW	Water Softener Outlet Flow Totalizer Alarm High	DI	-	By Vendor	gal	J701
AI-4083	AI	4083	SCW	Water Softener Outlet Hardness Analyzer Indication	AI	0.05	10	ppm	J701
AAH-4083	AAH	4083	SCW	Water Softener Outlet Hardness Analyzer Alarm High	DI	-	0.2	ppm	J701
PDAH-4084	PDAH	4084	SCW	Water Softener Outlet Strainer Differential Pressure Alarm High	DI	-	4	psig	J701
FAL-4101	FAL	4101	SCW	Hot Well Heat Recovery Pump Flow Alarm Low	DI	By Vendor	-	GPM	J701
PI-4104	PI	4104	SCW	Hot Well Heat Recovery Pump Inlet Pressure Indicator	AI	0	100	psig	J701
PAL-4104	PAL	4104	SCW	Hot Well Heat Recovery Pump Inlet Pressure Alarm Low	CALC	35	-	psig	J701
PDI-4104	PDI	4104	SCW	Hot Well Heat Recovery Pump Differential Pressure Indication	CALC	0	100	psig	J701
PI-4105	PI	4105	SCW	Hot Well Heat Recovery Pump Outlet Pressure Indicator	AI	0	100	psig	J701
XC-4106	XC	4106	SCW	Hot Well Heat Recovery Pump Control Output (FIC-4082)	DO	-	-	-	J701
SI-4106	SI	4106	SCW	Hot Well Heat Recovery Pump Speed Indication	AI	-	-	-	J701
HS-4122	HS	4122	SCW	Feedwater Tank Level Control Inlet Isolation Valve Control Output	DO	-	-	-	J701
ZIC-4122	ZIC	4122	SCW	Feedwater Tank Level Control Inlet Isolation Valve Position Indication Closed	DI	-	-	-	J701
ZIO-4122	ZIO	4122	SCW	Feedwater Tank Level Control Inlet Isolation Valve Position Indication Opened	DI	-	-	-	J701
PI-4134	PI	4134	SPW	Blowdown Pump HXP-2 Inlet Pressure Indication	AI	0	100	psig	J704
PDI-4134	PDI	4134	SPW	Blowdown Pump HXP-2 Differential Pressure Indication	CALC	0	100	psig	J704
PI-4135	PI	4135	SPW	Blowdown Pump HXP-2 Outlet Pressure Indication	AI	0	100	psig	J704
XC-4136	XC	4136	SPW	Blowdown Pump HXP-2 Control Output	DO	-	-	-	J704
YI-4136	YI	4136	SPW	Blowdown Pump HXP-2 Running Indication	DI	-	-	-	J704
II-4136	II	4136	SPW	Blowdown Pump HXP-2 Current Indication	AI	By Vendor	By Vendor	By Vendor	J704
IAL-4136	IAL	4136	SPW	Blowdown Pump HXP-2 Current Alarm Low	CALC	-	By Vendor	-	J704
IAH-4136	IAH	4136	SPW	Blowdown Pump HXP-2 Current Alarm High	CALC	-	By Vendor	-	J704
FAL-4137	FAL	4137	SPW	Blowdown Pump HXP-2 Flow Alarm Low	DI	By Vendor	-	GPM	J704
PI-4207	PI	4207	LPS	Steam Recovery to Deaerator Pressure Indication (PIC-5842)	AI	0	20	psig	J702
PC-4207	PC	4207	LPS	Steam Recovery to Deaerator Pressure Transmitter (PIC-5842)	AO	0	100	Percent	J702
PAL-4207	PAL	4207	LPS	Steam Recovery to Deaerator Pressure Alarm Low	DI	3	-	psig	J702
PAH-4207	PAH	4207	LPS	Steam Recovery to Deaerator Pressure Alarm High	DI	-	11	psig	J702
LI-4230	LI	4230	BFW	Feedwater Tank Level Indication (LIC-4230)	AI	0	100	Percent	J702

Remote I/O Instrument Point List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	P&ID DWG
LC-4230	LC	4230	BFW	Feedwater Tank Level Control Output (LIC-4230)	AO	0	100	Percent	J702
ZI-4230	ZI	4230	SCW	Feedwater Tank Drain Isolation Feedback	AI	0	100	Percent	J701
LALL-4230	LALL	4230	BFW	Feedwater Tank Level Transmitter Alarm Low, Low	CALC	22	-	Percent	J702
LAL-4230	LAL	4230	BFW	Feedwater Tank Level Transmitter Alarm Low	CALC	55	-	Percent	J702
LAH-4230	LAH	4230	BFW	Feedwater Tank Level Transmitter Alarm High	CALC	-	80	Percent	J702
LAHH-4230	LAHH	4230	BFW	Feedwater Tank Level Transmitter Alarm High, High	CALC	-	85	Percent	J702
PI-4231	PI	4231	BFW	Feedwater Tank Pressure Indication	AI	0	35	psig	J702
PAH-4231	PAH	4231	BFW	Feedwater Tank Pressure Alarm High	CALC	-	15	Percent	J702
TI-4233	TI	4233	BFW	Feedwater Tank Temperature Indication	RTD	0	250	°F	J702
ZI-4237	ZI	4237	BFD	Feedwater Tank Drain Isolation Valve Position Indication	DI	-	-	-	J705
ZIC-4300	ZIC	4300	BFS	Boiler FW Pump 1 Inlet Isolation Valve Position Indication Closed	DI	-	-	-	J706
ZIO-4300	ZIO	4300	BFS	Boiler FW Pump 1 Inlet Isolation Valve Position Indication Opened	DI	-	-	-	J706
PI-4304	PI	4304	BFS	Boiler FW Pump 1 Inlet Pressure Indication	AI	0	40	psig	J706
PDI-4304	PDI	4304	BFS	Boiler FW Pump 1 Differential Pressure Indication	CALC	0	570	psig	J706
PDAL-4304	PDAL	4304	BFS	Boiler FW Pump 1 Differential Pressure Alarm Low	CALC	480	-	psig	J706
PDAH-4304	PDAH	4304	BFS	Boiler FW Pump 1 Differential Pressure Alarm High	CALC	-	660	psig	J706
PI-4305	PI	4305	BFW	Boiler FW Pump 1 Outlet Pressure Indication	AI	0	1000	psig	J706
XC-4306	XC	4306	BFW	Boiler FW Pump 1 Control Output	AO	0	100	Percent	J706
SI-4306	SI	4306	BFW	Boiler FW Pump 1 Speed Indication (From VFD)	AI	0	100	Percent	J706
YA-4306	YA	4306	BFW	Boiler FW Pump 1 Motor Fault Alarm (From VFD)	DI	-	-	-	J706
II-4306	II	4306	BFW	Boiler FW Pump 1 Current Indication	AI	By Vendor	By Vendor	By Vendor	J706
IAH-4306	IAH	4306	BFW	Boiler FW Pump 1 Current Alarm High	CALC	-	By Vendor	-	J706
TI-4306	TI	4306	BFW	Boiler FW Pump 1 Motor Temperature Indication	RTD	By Vendor	By Vendor	°F	J706
TAH-4306	TAH	4306	BFW	Boiler FW Pump 1 Motor Temperature Alarm High	CALC	-	By Vendor	°F	J706
VI-4306	VI	4306	BFW	Boiler FW Pump 1 Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	J706
VAH-4306	VAH	4306	BFW	Boiler FW Pump 1 Motor Vibration Alarm High	CALC	-	By Vendor	-	J706
FI-4308	FI	4308	BFS	Boiler FW Pump 1 Flow Indication (FIC-4308)	AI	0	250,000	PPH	J706
FC-4308	FC	4308	BFS	Boiler FW Pump 1 Flow Recirculation Control Output (FIC-4308)	AO	0	100	Percent	J706
FAL-4308	FAL	4308	BFS	Boiler FW Pump 1 Flow Alarm Low	CALC	50	-	-	J706
ZI-4312	ZI	4312	BFW	Boiler FW Pump 1 Recirculation Valve Position Indication	AI	0	100	Percent	J706
ZIC-4330	ZIC	4330	BFS	Boiler FW Pump 2 Inlet Isolation Valve Position Indication Closed	DI	-	-	-	J706
ZIO-4330	ZIO	4330	BFS	Boiler FW Pump 2 Inlet Isolation Valve Position Indication Opened	DI	-	-	-	J706
PI-4334	PI	4334	BFS	Boiler FW Pump 2 Inlet Pressure Indicator	AI	0	40	psig	J706
PDI-4334	PDI	4334	BFS	Boiler FW Pump 2 Differential Pressure Indication	CALC	0	570	psig	J706
PDAL-4334	PDAL	4334	BFS	Boiler FW Pump 2 Differential Pressure Alarm Low	CALC	480	-	psig	J706
PDAH-4334	PDAH	4334	BFS	Boiler FW Pump 2 Differential Pressure Alarm High	CALC	-	660	psig	J706
PI-4335	PI	4335	BFW	Boiler FW Pump 2 Outlet Pressure Indication	AI	0	1000	psig	J706
XC-4336	XC	4336	BFW	Boiler FW Pump 2 Control Output	AO	0	100	Percent	J706
SI-4336	SI	4336	BFW	Boiler FW Pump 2 Speed Indication (From VFD)	AI	0	100	Percent	J706
YA-4336	YA	4336	BFW	Boiler FW Pump 2 Motor Fault Alarm (From VFD)	DI	-	-	-	J706
II-4336	II	4336	BFW	Boiler FW Pump 2 Current Indication	AI	By Vendor	By Vendor	By Vendor	J706
IAH-4336	IAH	4336	BFW	Boiler FW Pump 2 Current Alarm High	CALC	-	By Vendor	-	J706
TI-4336	TI	4336	BFW	Boiler FW Pump 2 Motor Temperature Indication	RTD	By Vendor	By Vendor	°F	J706
TAH-4336	TAH	4336	BFW	Boiler FW Pump 2 Motor Temperature Alarm High	CALC	-	By Vendor	°F	J706
VI-4336	VI	4336	BFW	Boiler FW Pump 2 Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	J706
VAH-4336	VAH	4336	BFW	Boiler FW Pump 2 Motor Vibration Alarm High	CALC	-	By Vendor	-	J706
FI-4338	FI	4338	BFS	Boiler FW Pump 2 Flow Indication (FIC-4338)	AI	0	250,000	PPH	J706

Remote I/O Instrument Point List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	P&ID DWG
FC-4338	FC	4338	BFS	Boiler FW Pump 2 Flow Recirculation Control Output (FIC-4338)	AO	0	100	Percent	J706
FAL-4338	FAL	4338	BFS	Boiler FW Pump 2 Flow Alarm Low	CALC	50	-	-	J706
ZI-4342	ZI	4342	BFW	Boiler FW Pump 2 Recirculation Valve Position Indication	AI	0	100	Percent	J706
ZIC-4360	ZIC	4360	BFS	Boiler FW Pump 3 Inlet Isolation Valve Position Indication Closed	DI	-	-	-	J706
ZIO-4360	ZIO	4360	BFS	Boiler FW Pump 3 Inlet Isolation Valve Position Indication Opened	DI	-	-	-	J706
PI-4364	PI	4364	BFS	Boiler FW Pump 3 Inlet Pressure Indication	AI	0	40	psig	J706
PDI-4364	PDI	4364	BFS	Boiler FW Pump 3 Differential Pressure Indication	CALC	0	570	psig	J706
PDAL-4364	PDAL	4364	BFS	Boiler FW Pump 3 Differential Pressure Alarm Low	CALC	480	-	psig	J706
PDAH-4364	PDAH	4364	BFS	Boiler FW Pump 3 Differential Pressure Alarm High	CALC	-	660	psig	J706
PI-4365	PI	4365	BFW	Boiler FW Pump 3 Outlet Pressure Indication	AI	0	1000	psig	J706
XC-4366	XC	4366	BFW	Boiler FW Pump 3 Control Output	AO	0	100	Percent	J706
SI-4366	SI	4366	BFW	Boiler FW Pump 3 Speed Indication (From VFD)	AI	0	100	Percent	J706
YA-4366	YA	4366	BFW	Boiler FW Pump 3 Motor Fault Alarm (From VFD)	DI	-	-	-	J706
II-4366	II	4366	BFW	Boiler FW Pump 3 Current Indication	AI	By Vendor	By Vendor	By Vendor	J706
IAH-4366	IAH	4366	BFW	Boiler FW Pump 3 Current Alarm High	CALC	-	By Vendor	-	J706
TI-4366	TI	4366	BFW	Boiler FW Pump 3 Motor Temperature Indication	RTD	By Vendor	By Vendor	°F	J706
TAH-4366	TAH	4366	BFW	Boiler FW Pump 3 Motor Temperature Alarm High	CALC	-	By Vendor	°F	J706
VI-4366	VI	4366	BFW	Boiler FW Pump 3 Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	J706
VAH-4366	VAH	4366	BFW	Boiler FW Pump 3 Motor Vibration Alarm High	CALC	-	By Vendor	-	J706
FI-4368	FI	4368	BFS	Boiler FW Pump 3 Flow Indication (FIC-4368)	AI	0	250,000	PPH	J706
FC-4368	FC	4368	BFS	Boiler FW Pump 3 Flow Recirculation Control Output (FIC-4368)	AO	0	100	Percent	J706
FAL-4368	FAL	4368	BFS	Boiler FW Pump 3 Flow Alarm Low	CALC	50	-	-	J706
ZI-4372	ZI	4372	BFW	Boiler FW Pump 3 Recirculation Valve Position Indication	AI	0	100	Percent	J706
SC-4405	SC	4405	Sulfite	Sulfite Pump CFP-1 Control Output	AO	Field Exp	Field Exp	Field Exp	J703
SI-4405	SI	4405	Sulfite	Sulfite Pump CFP-1 Speed Indication	AI	Field Exp	Field Exp	Field Exp	J703
PI-4406	PI	4406	Sulfite	Sulfite Pump CFP-1 Outlet Pressure Indication	AI	0	40	psig	J703
SC-4425	SC	4425	Filming Amine	Filming Amine Pump CFP-2A to FW Tank Control Output	AO	Field Exp	Field Exp	Field Exp	J703
SI-4425	SI	4425	Filming Amine	Filming Amine Pump CFP-2A to FW Tank Speed Indication	AI	Field Exp	Field Exp	Field Exp	J703
PI-4426	PI	4426	Filming Amine	Filming Amine Pump CFP-2A Outlet Pressure Indication	AI	0	40	psig	J703
SC-4435	SC	4435	Filming Amine	Filming Amine Pump CFP-2B to Steam Line Control Output	AO	Field Exp	Field Exp	Field Exp	J703
SI-4435	SI	4435	Filming Amine	Filming Amine Pump CFP-2B to Steam Line Speed Indication	AI	-	-	-	J703
PI-4436	PI	4436	Filming Amine	Filming Amine Pump CFP-2B Outlet Pressure Indication	AI	0	750	psig	J703
SC-4445	SC	4445	Phosphate	Phosphate Pump CFP-3A Control Output	AO	Field Exp	Field Exp	Field Exp	J703
SI-4445	SI	4445	Phosphate	Phosphate Pump CFP-3A Speed Indication	AI	Field Exp	Field Exp	Field Exp	J703
PI-4446	PI	4446	Phosphate	Phosphate Pump CFP-3A Outlet Pressure Indication	AI	0	750	psig	J703
SC-4455	SC	4455	Phosphate	Phosphate Pump CFP-3B Control Output	AO	Field Exp	Field Exp	Field Exp	J703
SI-4455	SI	4455	Phosphate	Phosphate Pump CFP-3B Speed Indication	AI	Field Exp	Field Exp	Field Exp	J703
PI-4456	PI	4456	Phosphate	Phosphate Pump CFP-3B Outlet Pressure Indication	AI	0	750	psig	J703
SC-4465	SC	4465	NL-90	NL-90 Pump CFP-4A Control Output	AO	Field Exp	Field Exp	Field Exp	J703
SI-4465	SI	4465	NL-90	NL-90 Pump CFP-4A Speed Indication	AI	Field Exp	Field Exp	Field Exp	J703
PI-4466	PI	4466	NL-90	NL-90 Pump CFP-4A Outlet Pressure Indication	AI	0	750	psig	J703
SC-4475	SC	4475	NL-90	NL-90 Pump CFP-4B Control Output	AO	Field Exp	Field Exp	Field Exp	J703
SI-4475	SI	4475	NL-90	NL-90 Pump CFP-4B Speed Indication	AI	Field Exp	Field Exp	Field Exp	J703
PI-4476	PI	4476	NL-90	NL-90 Pump CFP-4B Outlet Pressure Indication	AI	0	750	psig	J703
FI-5000	FI	5000	BFW	FW to Boiler 1 Flow Indication	AI	0	150	KPPH	J708
FQI-5000	FQI	5000	BFW	FW to Boiler 1 Flow Totalizer Indication	AI	-	-	Kilo-Pounds	J708
PI-5002	PI	5002	BFW	FW to Boiler 1 Pressure Indication	AI	0	1000	psig	J708

Remote I/O Instrument Point List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	P&ID DWG
PAL-5002	PAL	5002	BFW	FW to Boiler 1 Pressure Alarm Low	CALC	480	-	psig	J708
PAH-5002	PAH	5002	BFW	FW to Boiler 1 Pressure Alarm High	CALC	-	660	psig	J708
LIC-5005	LIC	5005	BFW	FW to Boiler 1 Control Valve Controller	AO	0	100	Percent	J708
ZI-5005	ZI	5005	BFW	FW to Boiler 1 Control Valve Position Indication	AI	0	100	Percent	J708
TI-5014	TI	5014	BFW	FW to Economizer 1 Temperature Indication	RTD	0	400	°F	J708
TI-5021	TI	5021	BFW	Economizer 1 Temperature Indication	RTD	0	400	°F	J708
LI-5100	LI	5100	HPS	Boiler 1 Steam Drum Level Indication	AI	By Vendor	By Vendor	By Vendor	J709
LAL-5100	LAL	5100	HPS	Boiler 1 Steam Drum Level Alarm Low	CALC	By Vendor	-	By Vendor	J709
LAH-5100	LAH	5100	HPS	Boiler 1 Steam Drum Level Alarm High	CALC	-	By Vendor	By Vendor	J709
LAHH-5100	LAHH	5100	HPS	Boiler 1 Steam Drum Level Alarm High High	CALC	-	By Vendor	By Vendor	J709
PI-5101	PI	5101	HPS	Boiler 1 Steam Drum Pressure Indication	AI	0	1000	psig	J709
PAL-5101	PAL	5101	HPS	Boiler 1 Steam Drum Pressure Alarm Low	CALC	By Vendor	-	psig	J709
LALL-5103	LALL	5103	HPS	Boiler 1 Steam Drum Pressure Alarm Low Low	DI	-	-	-	J709
PAH-5104	PAH	5104	HPS	Boiler 1 Steam Drum Pressure Alarm High	DI	-	-	-	J709
PAHH-5104	PAHH	5104	HPS	Boiler 1 Steam Drum Pressure Alarm High High	DI	-	-	-	J709
PI-5109	PI	5109	HPS	Boiler 1 Boiler Pressure Indication	AI	0	By Vendor	psig	J709
PAH-5109	PAH	5109	HPS	Boiler 1 Boiler Pressure Alarm High	CALC	-	By Vendor	psig	J709
FI-5111	FI	5111	HPS	Boiler 1 Steam Flow Indication	AI	0	150	KPPH	J709
FQI-5111	FQI	5111	HPS	Boiler 1 Steam Flow Totalizer Indication	AI	0	1,000,000	Kilo-Pounds	J709
FI-5200	FI	5200	BFW	FW to Boiler 2 Flow Indication	AI	0	150	KPPH	J710
FQI-5200	FQI	5200	BFW	FW to Boiler 2 Flow Totalizer Indication	AI	-	-	Kilo-Pounds	J710
PI-5202	PI	5202	BFW	FW to Boiler 2 Pressure Indication	AI	0	1000	psig	J710
PAL-5202	PAL	5202	BFW	FW to Boiler 2 Pressure Alarm Low	CALC	480	-	psig	J710
PAH-5202	PAH	5202	BFW	FW to Boiler 2 Pressure Alarm High	CALC	-	660	psig	J710
LIC-5205	LIC	5205	BFW	FW to Boiler 2 Control Valve Controller	AO	0	100	Percent	J710
ZI-5205	ZI	5205	BFW	FW to Boiler 2 Control Valve Position Indication	AI	0	100	Percent	J710
TI-5214	TI	5214	BFW	FW to Economizer 2 Temperature Indication	RTD	0	400	°F	J710
TI-5221	TI	5221	BFW	Economizer 2 Temperature Indication	RTD	0	400	°F	J710
LI-5300	LI	5300	HPS	Boiler 2 Steam Drum Level Indication	AI	By Vendor	By Vendor	By Vendor	J711
LAL-5300	LAL	5300	HPS	Boiler 2 Steam Drum Level Alarm Low	CALC	By Vendor	-	By Vendor	J711
LAH-5300	LAH	5300	HPS	Boiler 2 Steam Drum Level Alarm High	CALC	-	By Vendor	By Vendor	J711
LAHH-5300	LAHH	5300	HPS	Boiler 2 Steam Drum Level Alarm High High	CALC	-	By Vendor	By Vendor	J711
PI-5301	PI	5301	HPS	Boiler 2 Steam Drum Pressure Indication	AI	0	1000	psig	J711
PAL-5301	PAL	5301	HPS	Boiler 2 Steam Drum Pressure Alarm Low	CALC	By Vendor	-	psig	J711
LALL-5303	LALL	5303	HPS	Boiler 2 Steam Drum Pressure Alarm Low Low	DI	-	-	-	J711
PAH-5104	PAH	5304	HPS	Boiler 1 Steam Drum Pressure Alarm High	DI	-	-	-	J711
PAHH-5104	PAHH	5304	HPS	Boiler 1 Steam Drum Pressure Alarm High High	DI	-	-	-	J711
PI-5309	PI	5309	HPS	Boiler 2 Boiler Pressure Indication	AI	0	By Vendor	psig	J711
PAH-5309	PAH	5309	HPS	Boiler 2 Boiler Pressure Alarm High	CALC	-	By Vendor	psig	J711
FI-5311	FI	5311	HPS	Boiler 2 Steam Flow Indication	AI	0	150	KPPH	J711
FQI-5311	FQI	5311	HPS	Boiler 2 Steam Flow Totalizer Indication	AI	0	1,000,000	Kilo-Pounds	J711
FI-5400	FI	5400	BFW	FW to Boiler 3 Flow Indication	AI	0	150	KPPH	J712
FQI-5400	FQI	5400	BFW	FW to Boiler 1 Flow Totalizer Indication	AI	-	-	Kilo-Pounds	J712
PI-5402	PI	5402	BFW	FW to Boiler 3 Pressure Indication	AI	0	1000	psig	J712
PAL-5402	PAL	5402	BFW	FW to Boiler 3 Pressure Alarm Low	CALC	480	-	psig	J712
PAH-5402	PAH	5402	BFW	FW to Boiler 3 Pressure Alarm High	CALC	-	660	psig	J712
LIC-5405	LIC	5405	BFW	FW to Boiler 3 Control Valve Controller	AO	0	100	Percent	J712

Remote I/O Instrument Point List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	P&ID DWG
ZI-5405	ZI	5405	BFW	FW to Boiler 3 Control Valve Position Indication	AI	0	100	Percent	J712
TI-5414	TI	5414	BFW	FW to Economizer 3 Temperature Indication	RTD	0	400	°F	J712
TI-5421	TI	5421	BFW	Economizer 3 Temperature Indication	RTD	0	400	°F	J712
LI-5500	LI	5500	HPS	Boiler 3 Steam Drum Level Indication	AI	By Vendor	By Vendor	By Vendor	J713
LAL-5500	LAL	5500	HPS	Boiler 3 Steam Drum Level Alarm Low	CALC	By Vendor	-	By Vendor	J713
LAH-5500	LAH	5500	HPS	Boiler 3 Steam Drum Level Alarm High	CALC	-	By Vendor	By Vendor	J713
LAHH-5500	LAHH	5500	HPS	Boiler 3 Steam Drum Level Alarm High High	CALC	-	By Vendor	By Vendor	J713
PI-5501	PI	5501	HPS	Boiler 3 Steam Drum Pressure Indication	AI	0	1000	psig	J713
PAL-5501	PAL	5501	HPS	Boiler 3 Steam Drum Pressure Alarm Low	CALC	By Vendor	-	psig	J713
LALL-5303	LALL	5303	HPS	Boiler 2 Steam Drum Pressure Alarm Low Low	DI	-	-	-	J711
PAH-5504	PAH	5504	HPS	Boiler 3 Steam Drum Pressure Alarm High	DI	-	-	-	J713
PAHH-5504	PAHH	5504	HPS	Boiler 3 Steam Drum Pressure Alarm High High	DI	-	-	-	J713
PI-5509	PI	5509	HPS	Boiler 3 Boiler Pressure Indication	AI	0	By Vendor	psig	J713
PAH-5509	PAH	5509	HPS	Boiler 3 Boiler Pressure Alarm High	CALC	-	By Vendor	psig	J713
FI-5511	FI	5511	HPS	Boiler 3 Steam Flow Indication	AI	0	150	KPPH	J713
FQI-5511	FQI	5511	HPS	Boiler 3 Steam Flow Totalizer Indication	AI	0	1,000,000	Kilo-Pounds	J713
PI-5623	PI	5623	AHW	Auxiliary Hot Water Pump BFP-4 Inlet Pressure Indication	AI	0	40	psig	J702
PI-5624	PI	5624	AHW	Auxiliary Hot Water Pump BFP-4 Outlet Pressure Indication	AI	0	1000	psig	J702
CI-5700	CI	5700	HPS	Boiler 1 Steam Drum Conductivity Indication (CIC-5700)	AI	By Vendor	By Vendor	By Vendor	J709
CC-5700	CC	5700	HPS	Boiler 1 Steam Drum Conductivity Control Output (CIC-5700)	AO	0	100	Percent	J709
ZI-5700	ZI	5700	HPS	Boiler 1 Steam Line Conductivity Control Valve Position Indication	AI	0	100	Percent	J709
CI-5703	CI	5703	HPS	Boiler 2 Steam Drum Conductivity Indication (CIC-5703)	AI	By Vendor	By Vendor	By Vendor	J711
CC-5703	CC	5703	HPS	Boiler 2 Steam Drum Conductivity Control Output (CIC-5703)	AO	0	100	Percent	J711
ZI-5703	ZI	5703	HPS	Boiler 2 Steam Line Conductivity Control Valve Position Indication	AI	0	100	Percent	J711
CI-5706	CI	5706	HPS	Boiler 3 Steam Drum Conductivity Indication (CIC-5706)	AI	By Vendor	By Vendor	By Vendor	J713
CC-5706	CC	5706	HPS	Boiler 3 Steam Drum Conductivity Control Output (CIC-5706)	AO	0	100	Percent	J713
ZI-5706	ZI	5706	HPS	Boiler 3 Steam Line Conductivity Control Valve Position Indication	AI	0	100	Percent	J713
LI-5710	LI	5710	CBD	Continuous Blowdown Tank Level Indication (LIC-5710)	AI	0	100	Percent	J704
LC-5710	LC	5710	CBD	Continuous Blowdown Tank Level Control Output (LIC-5710)	AO	0	100	Percent	J704
LAH-5710	LAH	5710	CBD	Continuous Blowdown Tank Level Alarm High	CALC	0	100	Percent	J704
ZI-5710	ZI	5710	CBD	Intermittent Blowdown Level Control Valve Position Indication	AI	-	-	-	J705
FAL-5711	FAL	5711	CBD	Intermittent Blowdown Level Control Flow Alarm Low	DI	By Vendor	-	GPM	J704
XC-5717	XC	5717	CBD	Continuous Blowdown Pump HXP-3 Control Output	DO	-	-	-	J704
YI-5717	YI	5717	CBD	Continuous Blowdown Pump HXP-3 Running Indication	DI	-	-	-	J704
II-5717	II	5717	CBD	Continuous Blowdown Pump HXP-3 Current Indication	AI	By Vendor	By Vendor	By Vendor	J704
IAL-5717	IAL	5717	CBD	Continuous Blowdown Pump HXP-3 Current Alarm High	CALC	-	By Vendor	-	J704
IAH-5717	IAH	5717	CBD	Continuous Blowdown Pump HXP-3 Current Alarm High	CALC	-	By Vendor	-	J704
PI-5807	PI	5807	SVS	SVS Pressure Reducing Station Pressure Indication (PIC-5807)	AI	0	550	psig	J707
PC-5807	PC	5807	SVS	SVS Pressure Reducing Station Pressure Control Output (PIC-5807)	AO	0	100	Percent	J707
FI-5823	FI	5823	HPS	Steam Recirculation Flow Indication	AI	0	70,000	PPH	J707
FQI-5823	FQI	5823	HPS	Steam Recirculation Flow Totalizer	AI	0	1,000,000	CF	J707
XC-6000	XC	6000	DA	Boiler 1 Stack Fan Control Output	AO	0	100	Percent	J708
SI-6000	SI	6000	DA	Boiler 1 Stack Fan Speed Indication From VFD	AI	0	100	Percent	J708
YA-6000	YA	6000	DA	Boiler 1 Stack Fan Control Fault From VFD	DI	-	-	-	J708
II-6000	II	6000	DA	Boiler 1 Stack Fan Current Indication	AI	By Vendor	By Vendor	Amps	J708
IAH-6000	IAH	6000	DA	Boiler 1 Stack Fan Current Alarm High	CALC	-	By Vendor	-	J708
TI-6000	TI	6000	DA	Boiler 1 Stack Fan Motor Temperature Indication	RTD	By Vendor	By Vendor	°F	J708

Remote I/O Instrument Point List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	P&ID DWG
TAH-6000	TAH	6000	DA	Boiler 1 Stack Fan Motor Temperature Alarm High	CALC	-	By Vendor	-	J708
VI-6000	VI	6000	DA	Boiler 1 Stack Fan Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	J708
VAH-6000	VAH	6000	DA	Boiler 1 Stack Fan Motor Vibration Alarm High	CALC	-	By Vendor	-	J708
XC-6001	XC	6001	DA	Boiler 1 Stack Fan Control Output	AO	0	100	Percent	J708
SI-6001	SI	6001	DA	Boiler 1 Stack Fan Speed Indication Indication from VFD	AI	0	100	Percent	J708
YA-6001	YA	6001	DA	Boiler 1 Stack Fan Control Fault From VFD	DI	-	-	-	J708
II-6001	II	6001	DA	Boiler 1 Stack Fan Current Indication	AI	By Vendor	By Vendor	Amps	J708
IAH-6001	IAH	6001	DA	Boiler 1 Stack Fan Current Alarm High	CALC	-	By Vendor	-	J708
TI-6001	TI	6001	DA	Boiler 1 Stack Fan Motor Temperature Indication	RTD	By Vendor	By Vendor	°F	J708
TAH-6001	TAH	6001	DA	Boiler 1 Stack Fan Motor Temperature Alarm High	CALC	-	By Vendor	-	J708
VI-6001	VI	6001	DA	Boiler 1 Stack Fan Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	J708
VAH-6001	VAH	6001	DA	Boiler 1 Stack Fan Motor Vibration Alarm High	CALC	-	By Vendor	-	J708
PI-6006	PI	6006	DA	Boiler 1 Stack Fan A/B Outlet Pressure Indication	AI	0	By Vendor	psig	J708
PAL-6006	PAL	6006	DA	Boiler 1 Stack Fan A/B Outlet Pressure Alarm Low	CALC	By Vendor	-	psig	J708
PAH-6006	PAH	6006	DA	Boiler 1 Stack Fan A/B Outlet Pressure Alarm High	CALC	-	By Vendor	psig	J708
FAL-6007	FAL	6007	DA	Boiler 1 Stack Fan A/B Outlet Flow Alarm Low	DI	By Vendor	-	CFM	J708
AI-6011	AI	6011	Flue Gas	Boiler 1 Flue Gas Oxygen Analyzer Indication	AI	By Vendor	By Vendor	By Vendor	J708
TI-6012	TI	6012	Flue Gas	Boiler 1 Flue Gas Temperature Indication	RTD	By Vendor	By Vendor	°F	J708
PDI-6015	PDI	6015	Flue Gas	Boiler 1 Flue Gas SCR Differential Pressure Indication	AI	0	8	psig	J708
PDAH-6015	PDAH	6015	Flue Gas	Boiler 1 Flue Gas SCR Differential Pressure Alarm High	CALC	-	4	psig	J708
TI-6016	TI	6016	Flue Gas	Boiler 1 Flue Gas SCR Outlet Temperature Indication	RTD	By Vendor	By Vendor	°F	J708
TI-6023	TI	6023	Flue Gas	Flue Stack 1 Temperature Indication	RTD	By Vendor	By Vendor	°F	J708
ZIC-6030	ZIC	6030	Flue Gas	Flue Stack 1 Lid Closed Indication	DI	-	-	-	J708
PAL-6065	PAL	6065	NH3	Ammonia Supply 1 Pressure Alarm Low	DI	By Vendor	-	psig	J708
HS-6066	HS	6066	NH3	Ammonia Supply 1 On/Off Flow Control	DO	-	-	-	J708
ZIC-6066	ZIC	6066	NH3	Ammonia Supply 1 On/Off Flow Control Feedback Indication Open	DI	-	-	-	J708
ZIO-6066	ZIO	6066	NH3	Ammonia Supply 1 On/Off Flow Control Feedback Indication Closed	DI	-	-	-	J708
FI-6068	FI	6068	NH3	Ammonia Supply 1 Flow Indication	AI	0	By Vendor	cfm	J708
FC-6068	FC	6068	NH3	Ammonia Supply 1 Flow Control	DO	-	-	-	J708
FI-6101	FI	6101	Burner Air	Boiler 1 Combustion Air Flow Indication	AI	By Vendor	By Vendor	By Vendor	J709
FC-6101	FC	6101	Burner Air	Boiler 1 Combustion Air Flow Indication (FIC-6101)	AO	0	100	Percent	J709
FAL-6101	FAL	6101	Burner Air	Boiler 1 Combustion Air Flow Alarm Low	CALC	By Vendor	-	cfm	J709
FALL-6101	FALL	6101	Burner Air	Boiler 1 Combustion Air Flow Alarm Low, Low	CALC	-	By Vendor	cfm	J709
TI-6102	TI	6102	Burner Air	Boiler 1 Combustion Air Temperature Indication	RTD	0	120	°F	J709
XC-6103	XC	6103	DA	Boiler 1 Combustion Air Fan Control Output (Enables FIC-6101)	DO	0	100	Percent	J709
SI-6103	SI	6103	DA	Boiler 1 Combustion Air Fan Speed Indication from VFD	AI	0	100	Percent	J709
YA-6103	YA	6103	DA	Boiler 1 Combustion Air Fan Control Fault from VFD	DI	-	-	-	J709
II-6103	II	6103	DA	Boiler 1 Combustion Air Fan Current Indication	AI	By Vendor	By Vendor	Amps	J709
IAH-6103	IAH	6103	DA	Boiler 1 Combustion Air Fan Current Alarm High	CALC	-	By Vendor	-	J709
TI-6103	TI	6103	DA	Boiler 1 Combustion Air Fan Motor Temperature Indication	RTD	By Vendor	By Vendor	°F	J709
TAH-6103	TAH	6103	DA	Boiler 1 Combustion Air Fan Motor Temperature Alarm High	CALC	-	By Vendor	-	J709
VI-6103	VI	6103	DA	Boiler 1 Combustion Air Fan Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	J709
VAH-6103	VAH	6103	DA	Boiler 1 Combustion Air Fan Motor Vibration Alarm High	CALC	-	By Vendor	-	J709
XC-6200	XC	6200	DA	Boiler 2 Stack Fan Control Output	AO	0	100	Percent	J710
ZI-6200	ZI	6200	DA	Boiler 2 Stack Fan Control Feedback from VFD	AI	0	100	Percent	J710
YA-6200	YA	6200	DA	Boiler 2 Stack Fan Control Fault from VFD	DI	-	-	-	J710
II-6200	II	6200	DA	Boiler 2 Stack Fan Current Indication	AI	By Vendor	By Vendor	Amps	J710

Remote I/O Instrument Point List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	P&ID DWG
IAH-6200	IAH	6200	DA	Boiler 2 Stack Fan Current Alarm High	CALC	-	By Vendor	-	J710
TI-6200	TI	6200	DA	Boiler 2 Stack Fan Motor Temperature Indication	RTD	By Vendor	By Vendor	°F	J710
TAH-6200	TAH	6200	DA	Boiler 2 Stack Fan Motor Temperature Alarm High	CALC	-	By Vendor	-	J710
VI-6200	VI	6200	DA	Boiler 2 Stack Fan Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	J710
VAH-6200	VAH	6200	DA	Boiler 2 Stack Fan Motor Vibration Alarm High	CALC	-	By Vendor	-	J710
XC-6201	XC	6201	DA	Boiler 2 Stack Fan Control Output	AO	0	100	Percent	J710
SI-6201	SI	6201	DA	Boiler 2 Stack Fan Speed Indication from VFD	AI	0	100	Percent	J710
YA-6201	YA	6201	DA	Boiler 2 Stack Fan Control Fault from VFD	CALC	-	-	-	J710
II-6201	II	6201	DA	Boiler 2 Stack Fan Current Indication	AI	By Vendor	By Vendor	Amps	J710
IAH-6201	IAH	6201	DA	Boiler 2 Stack Fan Current Alarm High	CALC	-	By Vendor	-	J710
TI-6201	TI	6201	DA	Boiler 2 Stack Fan Motor Temperature Indication	RTD	By Vendor	By Vendor	°F	J710
TAH-6201	TAH	6201	DA	Boiler 2 Stack Fan Motor Temperature Alarm High	CALC	-	By Vendor	-	J710
VI-6201	VI	6201	DA	Boiler 2 Stack Fan Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	J710
VAH-6201	VAH	6201	DA	Boiler 2 Stack Fan Motor Vibration Alarm High	CALC	-	By Vendor	-	J710
PI-6206	PI	6206	DA	Boiler 2 Stack Fan A/B Outlet Pressure Indication	AI	0	By Vendor	psig	J710
PAL-6206	PAL	6206	DA	Boiler 2 Stack Fan A/B Outlet Pressure Alarm Low	CALC	By Vendor	-	psig	J710
PAH-6206	PAH	6206	DA	Boiler 2 Stack Fan A/B Outlet Pressure Alarm High	CALC	-	By Vendor	psig	J710
FAL-6207	FAL	6207	DA	Boiler 2 Stack Fan A/B Outlet Flow Alarm Low	DI	By Vendor	-	CFM	J710
AI-6211	AI	6211	Flue Gas	Boiler 2 Flue Gas Oxygen Analyzer Indication	AI	By Vendor	By Vendor	By Vendor	J710
TI-6212	TI	6212	Flue Gas	Boiler 2 Flue Gas Temperature Indication	RTD	By Vendor	By Vendor	°F	J710
PDI-6215	PDI	6215	Flue Gas	Boiler 2 Flue Gas SCR Differential Pressure Indication	AI	0	8	psig	J708
PDAH-6215	PDAH	6215	Flue Gas	Boiler 2 Flue Gas SCR Differential Pressure Alarm High	CALC	-	4	psig	J708
TI-6216	TI	6216	Flue Gas	Boiler 2 Flue Gas SCR Outlet Temperature Indication	RTD	By Vendor	By Vendor	°F	J710
TI-6223	TI	6223	Flue Gas	Flue Stack 2 Temperature Indication	RTD	By Vendor	By Vendor	°F	J710
ZIC-6230	ZIC	6230	Flue Gas	Flue Stack 2 Lid Closed Indication	DI	-	-	-	J710
PAL-6265	PAL	6265	NH3	Ammonia Supply 2 Pressure Alarm Low	DI	By Vendor	-	psig	J710
HS-6266	HS	6266	NH3	Ammonia Supply 2 On/Off Flow Control	DO	-	-	-	J710
ZIC-6266	ZIC	6266	NH3	Ammonia Supply 2 On/Off Flow Control Feedback Indication Open	DI	-	-	-	J710
ZIO-6266	ZIO	6266	NH3	Ammonia Supply 2 On/Off Flow Control Feedback Indication Closed	DI	-	-	-	J710
FI-6268	FI	6268	NH3	Ammonia Supply 2 Flow Indication	AI	0	By Vendor	cfm	J710
XC-6268	XC	6268	NH3	Ammonia Supply 2 Flow Control	DO	-	-	-	J710
FI-6301	FI	6301	Burner Air	Boiler 2 Combustion Air Flow Indication	AI	By Vendor	By Vendor	cfm	J711
FC-6301	FC	6301	Burner Air	Boiler 2 Combustion Air Flow Indication (FIC-6301)	AO	0	100	Percent	J709
FAL-6301	FAL	6301	Burner Air	Boiler 2 Combustion Air Flow Alarm Low	CALC	By Vendor	-	cfm	J711
FALL-6301	FALL	6301	Burner Air	Boiler 2 Combustion Air Flow Alarm Low, Low	CALC	-	By Vendor	cfm	J711
TI-6302	TI	6302	Burner Air	Boiler 2 Combustion Air Temperature Indication	RTD	0	120	°F	J711
XC-6303	XC	6303	DA	Boiler 2 Combustion Air Fan Control Output (Enables FIC-6301)	DO	0	100	Percent	J711
SI-6303	SI	6303	DA	Boiler 2 Combustion Air Fan Speed Indication from VFD	AI	0	100	Percent	J711
YA-6303	YA	6303	DA	Boiler 2 Combustion Air Fan Control Fault from VFD	DI	-	-	-	J711
II-6303	II	6303	DA	Boiler 2 Combustion Air Fan Current Indication	AI	By Vendor	By Vendor	Amps	J711
IAH-6303	IAH	6303	DA	Boiler 2 Combustion Air Fan Current Alarm High	CALC	-	By Vendor	-	J711
TI-6303	TI	6303	DA	Boiler 2 Combustion Air Fan Motor Temperature Indication	RTD	By Vendor	By Vendor	°F	J711
TAH-6303	TAH	6303	DA	Boiler 2 Combustion Air Fan Motor Temperature Alarm High	CALC	-	By Vendor	-	J711
VI-6303	VI	6303	DA	Boiler 2 Combustion Air Fan Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	J711
VAH-6303	VAH	6303	DA	Boiler 2 Combustion Air Fan Motor Vibration Alarm High	CALC	-	By Vendor	-	J711
XC-6400	XC	6400	DA	Boiler 3 Stack Fan Control Output	AO	0	100	Percent	J712
SI-6400	SI	6400	DA	Boiler 3 Stack Fan Speed Indication from VFD	AI	0	100	Percent	J712

Remote I/O Instrument Point List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	P&ID DWG
YA-6400	YA	6400	DA	Boiler 3 Stack Fan Control Fault from VFD	DI	-	-	-	J712
II-6400	II	6400	DA	Boiler 3 Stack Fan Current Indication	AI	By Vendor	By Vendor	Amps	J712
IAH-6400	IAH	6400	DA	Boiler 3 Stack Fan Current Alarm High	CALC	-	By Vendor	-	J712
TI-6400	TI	6400	DA	Boiler 3 Stack Fan Motor Temperature Indication	RTD	By Vendor	By Vendor	°F	J712
TAH-6400	TAH	6400	DA	Boiler 3 Stack Fan Motor Temperature Alarm High	CALC	-	By Vendor	-	J712
VI-6400	VI	6400	DA	Boiler 3 Stack Fan Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	J712
VAH-6400	VAH	6400	DA	Boiler 3 Stack Fan Motor Vibration Alarm High	CALC	-	By Vendor	-	J712
XC-6401	XC	6401	DA	Boiler 3 Stack Fan Control Output	AO	0	100	Percent	J712
SI-6401	SI	6401	DA	Boiler 3 Stack Fan Speed Indication from VFD	AI	0	100	Percent	J712
YA-6401	YA	6401	DA	Boiler 3 Stack Fan Control Fault from VFD	DI	-	-	-	J712
II-6401	II	6401	DA	Boiler 3 Stack Fan Current Indication	AI	By Vendor	By Vendor	Amps	J712
IAH-6401	IAH	6401	DA	Boiler 3 Stack Fan Current Alarm High	CALC	-	By Vendor	-	J712
TI-6401	TI	6401	DA	Boiler 3 Stack Fan Motor Temperature Indication	RTD	By Vendor	By Vendor	°F	J712
TAH-6401	TAH	6401	DA	Boiler 3 Stack Fan Motor Temperature Alarm High	CALC	-	By Vendor	-	J712
VI-6401	VI	6401	DA	Boiler 3 Stack Fan Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	J712
VAH-6401	VAH	6401	DA	Boiler 3 Stack Fan Motor Vibration Alarm High	CALC	-	By Vendor	-	J712
PI-6406	PI	6406	DA	Boiler 3 Stack Fan A/B Outlet Pressure Indication	AI	0	By Vendor	psig	J712
PAL-6406	PAL	6406	DA	Boiler 3 Stack Fan A/B Outlet Pressure Alarm Low	CALC	By Vendor	-	psig	J712
PAH-6406	PAH	6406	DA	Boiler 3 Stack Fan A/B Outlet Pressure Alarm High	CALC	-	By Vendor	psig	J712
FAL-6407	FAL	6407	DA	Boiler 3 Stack Fan A/B Outlet Flow Alarm Low	DI	By Vendor	-	CFM	J712
AI-6411	AI	6411	Flue Gas	Boiler 3 Flue Gas Oxygen Analyzer Indication	AI	By Vendor	By Vendor	By Vendor	J712
TI-6412	TI	6412	Flue Gas	Boiler 3 Flue Gas Temperature Indication	RTD	By Vendor	By Vendor	°F	J712
PDI-6415	PDI	6415	Flue Gas	Boiler 3 Flue Gas SCR Differential Pressure Indication	AI	0	8	psig	J708
PDAH-6415	PDAH	6415	Flue Gas	Boiler 3 Flue Gas SCR Differential Pressure Alarm High	CALC	-	4	psig	J708
TI-6416	TI	6416	Flue Gas	Boiler 3 Flue Gas SCR Outlet Temperature Indication	RTD	By Vendor	By Vendor	°F	J712
TI-6423	TI	6423	Flue Gas	Flue Stack 3 Temperature Indication	RTD	By Vendor	By Vendor	°F	J712
ZIC-6430	ZIC	6430	Flue Gas	Flue Stack 3 Lid Closed Indication	DI	-	-	-	J712
PAL-6465	PAL	6465	NH3	Ammonia Supply 3 Pressure Alarm Low	DI	By Vendor	-	psig	J712
HS-6466	HS	6466	NH3	Ammonia Supply 3 On/Off Flow Control	DO	-	-	-	J712
ZIC-6466	ZIC	6466	NH3	Ammonia Supply 3 On/Off Flow Control Feedback Indication Open	DI	-	-	-	J712
ZIO-6466	ZIO	6466	NH3	Ammonia Supply 3 On/Off Flow Control Feedback Indication Closed	DI	-	-	-	J712
FI-6468	FI	6468	NH3	Ammonia Supply 3 Flow Indication	AI	0	By Vendor	cfm	J712
XC-6468	XC	6468	NH3	Ammonia Supply 3 Flow Control	DO	-	-	-	J712
FI-6501	FI	6501	Burner Air	Boiler 3 Combustion Air Flow Indication	AI	By Vendor	By Vendor	cfm	J713
FC-6501	FC	6501	Burner Air	Boiler 2 Combustion Air Flow Indication (FIC-6501)	AO	0	100	Percent	J709
FAL-6501	FAL	6501	Burner Air	Boiler 3 Combustion Air Flow Alarm Low	CALC	By Vendor	-	cfm	J713
FALL-6501	FALL	6501	Burner Air	Boiler 3 Combustion Air Flow Alarm Low, Low	CALC	-	By Vendor	cfm	J713
TI-6502	TI	6502	Burner Air	Boiler 3 Combustion Air Temperature Indication	RTD	0	120	°F	J713
XC-6503	XC	6503	DA	Boiler 3 Combustion Air Fan Control Output (Enables FIC-6501)	DO	0	100	Percent	J713
SI-6503	SI	6503	DA	Boiler 3 Combustion Air Fan Speed Indication from VFD	AI	0	100	Percent	J713
YA-6503	YA	6503	DA	Boiler 3 Combustion Air Fan Control Fault from VFD	CALC	-	-	-	J713
II-6503	II	6503	DA	Boiler 3 Combustion Air Fan Current Indication	AI	By Vendor	By Vendor	Amps	J713
IAH-6503	IAH	6503	DA	Boiler 3 Combustion Air Fan Current Alarm High	CALC	-	By Vendor	-	J713
TI-6503	TI	6503	DA	Boiler 3 Combustion Air Fan Motor Temperature Indication	RTD	By Vendor	By Vendor	°F	J713
TAH-6503	TAH	6503	DA	Boiler 3 Combustion Air Fan Motor Temperature Alarm High	CALC	-	By Vendor	-	J713
VI-6503	VI	6503	DA	Boiler 3 Combustion Air Fan Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	J713
VAH-6503	VAH	6503	DA	Boiler 3 Combustion Air Fan Motor Vibration Alarm High	CALC	-	By Vendor	-	J713

Remote I/O Instrument Point List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	P&ID DWG
PAH-6604	PAH	6604	NH3	Anhydrous Ammonia Tank Relief Valve Discharge Line Pressure Alarm High	DI	-	25	psig	j715
LI-6606	LI	6606	NH3	Anhydrous Ammonia Tank Level Indicator	AI	0	100	Percent	J715
ZIC-6609	ZIC	6609	NH3	Anhydrous Ammonia 3/4" Line Emergency Valve Feedback Indication Closed	DI	-	-	-	j715
HS-6610	HS	6610	NH3	Anhydrous Ammonia 3/4" Line Isolation Valve On/Off Control Output	DO	-	-	-	j715
ZIC-6610	ZIC	6610	NH3	Anhydrous Ammonia 3/4" Line Isolation Valve Feedback Indication Closed	DI	-	-	-	j715
TI-6621	TI	6621	NH3	Ammonia Diffusion Tank Temperature Indication	RTD	0	200	°F	j715
TAH-6621	TAH	6621	NH3	Ammonia Diffusion Tank Temperature Alarm High	CALC	-	80	°F	j715
TAHH-6621	TAHH	6621	NH3	Ammonia Diffusion Tank Temperature Alarm High-High	CALC	-	100	°F	j715
TKA-6621	TKA	6621	NH3	Ammonia Diffusion Tank Temperature Rate-Of-Change Alarm (2 min average)	CALC	-	1	F°/min	j715
PI-6742	PI	6742	A	Shop Air From N231 Receiver Tank Pressure Indication	AI	0	180	psig	J714
PAL-6742	PAL	6742	A	Shop Air From N231 Receiver Tank Pressure Alarm Low	CALC	85	-	psig	J714
PI-6752	PI	6752	IA	Instrument Air From N229A Receiver Tank Pressure Indication	AI	0	180	psig	J714
PAL-6752	PAL	6752	IA	Instrument Air From N229A Receiver Tank Pressure Alarm Low	CALC	85	-	psig	J714

"**Service**" Abbreviations:	
A	Air (Shop)
AHW	Auxiliary Hot Water
AUX	Auxiliary Steam to Deaerator Tank
BFD	Boiler Feedwater Drain
BFS	Boiler Feedwater Suction
BFW	Boiler Feedwater
CBD	Continuous Blowdown
DA	Draft Air
G	Gas (Reduced Pressure Natural Gas)
HPS	High Pressure Steam
IA	Instrument Air
IBD	Intermittent Blowdown
IW	Industrial Waste (Water)
LPS	Low Pressure Steam
MPG	Medium Pressure Gas (Natural Gas)
MU	Make-Up Water
NH3	Ammonia
RO	Reverse Osmosis Water
SCW	Softened Cold Water
SPW	Soft Preheated Water
SVS	Steam Vacuum System

Points	
145	Analog Inputs
33	Analog Outputs
60	Digital Inputs
14	Digital Outputs
32	RTD Inputs

Appendix C

BALANCE OF PLANT INSTRUMENT LIST

Balance of Plant Instrument List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	Fluid	Process Pipe Size	Temp Min (F)	Temp Max (F)	Press Max (psig)	P&ID DWG	Installation DWG
FQIT-3005	FQIT	3005	MPG	Natural Gas Supply Flow Indicating Transmitter w/ Totalizer	Field	0	10,000	PPH	Nat Gas	8	35	100	100	J714	J514
FI-3005	FI	3005	MPG	Natural Gas Supply Flow Indication	AI	0	10,000	PPH	-	-	-	-	-	J714	-
FQI-3005	FQI	3005	MPG	Natural Gas Supply Flow Totalizer	AI	0	1,000,000	Kilo-Pounds	-	-	-	-	-	J714	-
PI-3009	PI	3009	MPG	Natural Gas Supply Local Pressure Indicator	Field	0	50	psig	Nat Gas	8	35	100	100	J714	J503
PT-3010	PT	3010	MPG	Natural Gas Supply Pressure Transmitter	Field	0	50	psig	Nat Gas	8	35	100	100	J714	J501/502
PI-3010	PI	3010	MPG	Natural Gas Supply Pressure Indication	AI	0	50	psig	-	-	-	-	-	J714	-
PAL-3010	PAL	3010	MPG	Natural Gas Supply Pressure Alarm Low	DI	20	-	psig	-	-	-	-	-	J714	-
FQIT-3100	FQIT	3100	G	Natural Gas Supply to Boiler 1 Flow Indicating Transmitter w/Totalizer	Field	0	10,000	PPH	Nat Gas	6	35	100	100	J709	J514
FI-3100	FI	3100	G	Natural Gas Supply to Boiler 1 Flow Indication	AI	0	10,000	PPH	-	-	-	-	-	J709	-
FQI-3100	FQI	3100	G	Natural Gas Supply to Boiler 1 Flow Totalizer	AI	0	1,000,000	Kilo-Pounds	-	-	-	-	-	J709	-
FQIT-3200	FQIT	3200	G	Natural Gas Supply to Boiler 2 Flow Indicating Transmitter w/Totalizer	Field	0	10,000	PPH	Nat Gas	6	35	100	100	J711	J514
FI-3200	FI	3200	G	Natural Gas Supply to Boiler 2 Flow Indication	AI	0	10,000	PPH	-	-	-	-	-	J711	-
FQI-3200	FQI	3200	G	Natural Gas Supply to Boiler 2 Flow Totalizer	AI	0	1,000,000	Kilo-Pounds	-	-	-	-	-	J711	-
FQIT-3300	FQIT	3300	G	Natural Gas Supply to Boiler 3 Flow Indicating Transmitter w/Totalizer	Field	0	10,000	PPH	Nat Gas	6	35	100	100	J713	J514
FI-3300	FI	3300	G	Natural Gas Supply to Boiler 3 Flow Indication	AI	0	10,000	PPH	-	-	-	-	-	J713	-
FQI-3300	FQI	3300	G	Natural Gas Supply to Boiler 3 Flow Totalizer	AI	0	1,000,000	Kilo-Pounds	-	-	-	-	-	J713	-
PI-4006	PI	4006	RO	Reverse Osmosis Water Supply Pressure Indicator (Before Flow Control Valve)	Field	0	100	psig	Water	6	35	100	100	J701	J503
PI-4008	PI	4008	RO	Reverse Osmosis Water Supply Pressure Indicator (After Flow Control Valve)	Field	0	100	psig	Water	6	35	100	100	J701	J503
PIT-4009	PIT	4009	RO	Reverse Osmosis Water Supply Pressure Indicating Transmitter	Field	0	100	psig	Water	6	35	100	100	J701	J501/502
FSL-4012	FSL	4012	IW	Boiler FW Pump 1 Cooling Water Flow Switch Low	Field	By Vendor	-	gpm	Water	0.5	35	100	100	J706	J515
FAL-4012	FAL	4012	IW	Boiler FW Pump 1 Cooling Water Flow Alarm Low	DI	-	-	-	-	-	-	-	-	J706	-
FSL-4017	FSL	4017	IW	Boiler FW Pump 2 Cooling Water Flow Switch Low	Field	By Vendor	-	gpm	Water	0.5	35	100	100	J706	J515
FAL-4017	FAL	4017	IW	Boiler FW Pump 2 Cooling Water Flow Alarm Low	DI	-	-	-	-	-	-	-	-	J706	-
FSL-4022	FSL	4022	IW	Boiler FW Pump 3 Cooling Water Flow Switch Low	Field	By Vendor	-	gpm	Water	0.5	35	100	100	J706	J515
FAL-4022	FAL	4022	IW	Boiler FW Pump 3 Cooling Water Flow Alarm Low	DI	-	-	-	-	-	-	-	-	J706	-
PIT-4071	PIT	4071	MU	Water Softener Inlet Pressure Indicating Transmitter	Field	0	100	psig	Water	6	35	100	100	J701	J501/502
PI-4071	PI	4071	MU	Water Softener Inlet Pressure Indication	AI	0	100	psig	-	-	-	-	-	J701	-
PIT-4081	PIT	4081	SCW	Water Softener Outlet Pressure Indicating Transmitter	Field	0	100	psig	Water	6	35	100	100	J701	J501/502
PI-4081	PI	4081	SCW	Water Softener Outlet Pressure Indication	AI	0	100	psig	-	-	-	-	-	J701	-
PAL-4081	PAL	4081	SCW	Water Softener Outlet Pressure Alarm Low	CALC	35	-	psig	-	-	-	-	-	J701	-
FQIT-4082	FQIT	4082	SCW	Water Softener Outlet Flow Indicating Transmitter w/ Totalizer	Field	0	500,000	PPH	Water	6	35	100	100	J701	J514
FI-4082	FI	4082	SCW	Water Softener Outlet Flow Indication (FIC-4082 controls XC-4106)	AI	0	500,000	PPH	-	-	-	-	-	J701	-
FC-4082	FC	4082	BFS	Water Softener Outlet Flow Control Output (FIC-4082 controls XC-4106)	AO	0	100	Percent	-	-	-	-	-	J701	-
FQI-4082	FQI	4082	SCW	Water Softener Outlet Flow Totalizer	AI	0	1,000,000	gal	-	-	-	-	-	J701	-
FQAH-4082	FQAH	4082	SCW	Water Softener Outlet Flow Totalizer Alarm High	DI	-	By Vendor	gal	-	-	-	-	-	J701	-
AIT-4083	AIT	4083	SCW	Water Softener Outlet Hardness Analyzer Indicating Transmitter	Field	0.05	10	ppm	Water	6	35	100	100	J701	-
AI-4083	AI	4083	SCW	Water Softener Outlet Hardness Analyzer Indication	AI	0.05	10	ppm	-	-	-	-	-	J701	-
AAH-4083	AAH	4083	SCW	Water Softener Outlet Hardness Analyzer Alarm High	DI	-	0.2	ppm	-	-	-	-	-	J701	-
PDIS-4084	PDIS	4084	SCW	Water Softener Outlet Strainer Differential Pressure Switch	Field	0	4	psig	Water	6	35	100	100	J701	J505
PDAH-4084	PDAH	4084	SCW	Water Softener Outlet Strainer Differential Pressure Alarm High	DI	-	4	psig	-	-	-	-	-	J701	-
FSL-4101	FSL	4101	SCW	Hot Well Heat Recovery Pump Flow Switch	Field	By Vendor	-	GPM	Water	6	35	100	100	J701	J515
FAL-4101	FAL	4101	SCW	Hot Well Heat Recovery Pump Flow Alarm Low	DI	By Vendor	-	-	GPM	-	-	-	-	J701	-
PIT-4104	PIT	4104	SCW	Hot Well Heat Recovery Pump Inlet Pressure Indicating Transmitter	Field	0	100	psig	Water	6	35	100	100	J701	J501/502
PI-4104	PI	4104	SCW	Hot Well Heat Recovery Pump Inlet Pressure Indicator	AI	0	100	psig	-	-	-	-	-	J701	-
PAL-4104	PAL	4104	SCW	Hot Well Heat Recovery Pump Inlet Pressure Alarm Low	CALC	35	-	psig	-	-	-	-	-	J701	-
PDI-4104	PDI	4104	SCW	Hot Well Heat Recovery Pump Differential Pressure Indication	CALC	0	100	psig	-	-	-	-	-	J701	-
PIT-4105	PIT	4105	SCW	Hot Well Heat Recovery Pump Outlet Pressure Indicating Transmitter	Field	0	100	psig	Water	6	35	100	100	J701	J501/502
PI-4105	PI	4105	SCW	Hot Well Heat Recovery Pump Outlet Pressure Indicator	AI	0	100	psig	-	-	-	-	-	J701	-
HS-4106	HS	4106	SCW	Hot Well Heat Recovery Pump HOA Switch	Field	-	-	-	-	-	35	100	-	J701	-
XC-4106	XC	4106	SCW	Hot Well Heat Recovery Pump Control Output (FIC-4082)	DO	-	-	-	-	-	-	-	-	J701	-
SI-4106	SI	4106	SCW	Hot Well Heat Recovery Pump Speed Indication	AI	-	-	-	-	-	-	-	-	J701	-
HS-4122	HS	4122	SCW	Feedwater Tank Level Control Inlet Isolation Valve Control Output	DO	-	-	-	-	-	-	-	-	J701	-
ZSC-4122	ZSC	4122	SCW	Feedwater Tank Level Control Inlet Isolation Valve Position Switch Closed	Field	-	-	-	-	-	-	-	-	J701	-
ZSO-4122	ZSO	4122	SCW	Feedwater Tank Level Control Inlet Isolation Valve Position Switch Opened	Field	-	-	-	-	-	-	-	-	J701	-
ZIC-4122	ZIC	4122	SCW	Feedwater Tank Level Control Inlet Isolation Valve Position Indication Closed	DI	-	-	-	-	-	-	-	-	J701	-
ZIO-4122	ZIO	4122	SCW	Feedwater Tank Level Control Inlet Isolation Valve Position Indication Opened	DI	-	-	-	-	-	-	-	-	J701	-

Balance of Plant Instrument List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	Fluid	Process Pipe Size	Temp Min (F)	Temp Max (F)	Press Max (psig)	P&ID DWG	Installation DWG
FS-4123	FS	4123	SCW	Feedwater Tank Level Control Flow Switch	Field	-	By Vendor	GPM	Water	6	35	100	100	J701	J515
PIT-4134	PIT	4134	SPW	Blowdown Pump HXP-2 Inlet Pressure Indicating Transmitter	Field	0	100	psig	Water	1.5	35	100	100	J704	J501/502
PI-4134	PI	4134	SPW	Blowdown Pump HXP-2 Inlet Pressure Indication	AI	0	100	psig	-	-	-	-	-	J704	-
PDI-4134	PDI	4134	SPW	Blowdown Pump HXP-2 Differential Pressure Indication	CALC	0	100	psig	-	-	-	-	-	J704	-
PIT-4135	PIT	4135	SPW	Blowdown Pump HXP-2 Outlet Pressure Indicating Transmitter	Field	0	100	psig	Water	1.5	35	100	100	J704	J501/502
PI-4135	PI	4135	SPW	Blowdown Pump HXP-2 Outlet Pressure Indication	AI	0	100	psig	-	-	-	-	-	J704	-
HS-4136	HS	4136	SPW	Blowdown Pump HXP-2 HOA Switch	Field	-	-	-	-	-	35	100	-	J704	-
XC-4136	XC	4136	SPW	Blowdown Pump HXP-2 Control Output	DO	-	-	-	-	-	-	-	-	J704	-
YS-4136	YS	4136	SPW	Blowdown Pump HXP-2 Running Switch	Field	-	-	-	-	-	-	-	-	J704	-
YI-4136	YI	4136	SPW	Blowdown Pump HXP-2 Running Indication	DI	-	-	-	-	-	-	-	-	J704	-
IT-4136	IT	4136	SPW	Blowdown Pump HXP-2 Current Transmitter	Field	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J704	-
II-4136	II	4136	SPW	Blowdown Pump HXP-2 Current Indication	AI	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J704	-
IAL-4136	IAL	4136	SPW	Blowdown Pump HXP-2 Current Alarm Low	CALC	-	By Vendor	-	-	-	-	-	-	J704	-
IAH-4136	IAH	4136	SPW	Blowdown Pump HXP-2 Current Alarm High	CALC	-	By Vendor	-	-	-	-	-	-	J704	-
FSL-4137	FSL	4137	SPW	Blowdown Pump HXP-2 Flow Switch	Field	By Vendor	-	GPM	Water	1.5	35	100	100	J704	J515
FAL-4137	FAL	4137	SPW	Blowdown Pump HXP-2 Flow Alarm Low	DI	By Vendor	-	GPM	-	-	-	-	-	J704	-
PI-4141	PI	4141	SPW	Softened Water to HX-2 Inlet Local Pressure Indicator	Field	0	100	psig	Water	1.5	35	100	100	J704	J503
PI-4144	PI	4144	SPW	Softened Water from HX-2 Outlet Local Pressure Indicator	Field	0	100	psig	Water	1.5	35	100	100	J704	J503
TI-4205	TI	4205	BFW	Deaerator Tank Local Temperature Indicator	Field	0	250	°F	Water	-	0	275	30	J702	J506/507
PI-4206	PI	4206	LPS	Steam Recovery to Deaerator Local Pressure Indicator	Field	0	20	psig	Steam	16	35	230	7	J702	J503
PT-4207	PT	4207	LPS	Steam Recovery to Deaerator Pressure Transmitter	Field	0	20	psig	Steam	16	35	230	7	J702	J501/502
PI-4207	PI	4207	LPS	Steam Recovery to Deaerator Pressure Indication (PIC-5842)	AI	0	20	psig	-	-	-	-	-	J702	-
PC-4207	PC	4207	LPS	Steam Recovery to Deaerator Pressure Transmitter (PIC-5842)	AO	0	100	Percent	-	-	-	-	-	J702	-
PAL-4207	PAL	4207	LPS	Steam Recovery to Deaerator Pressure Alarm Low	DI	3	-	psig	-	-	-	-	-	J702	-
PAH-4207	PAH	4207	LPS	Steam Recovery to Deaerator Pressure Alarm High	DI	-	11	psig	-	-	-	-	-	J702	-
LT-4230	LT	4230	BFW	Feedwater Tank Level Transmitter	Field	0	100	Percent	Water	-	35	275	30	J702	J509/510
LI-4230	LI	4230	BFW	Feedwater Tank Level Indication (LIC-4230)	AI	0	100	Percent	-	-	-	-	-	J702	-
LC-4230	LC	4230	BFW	Feedwater Tank Level Control Output (LIC-4230)	AO	0	100	Percent	-	-	-	-	-	J702	-
LY-4230	LY	4230	SCW	Feedwater Tank Level Control Positioner	Field	0	100	Percent	Water	-	35	230	30	J701	-
ZT-4230	ZT	4230	SCW	Feedwater Tank Drain Isolation Feedback	Field	-	-	-	-	-	-	-	-	J701	-
ZI-4230	ZI	4230	SCW	Feedwater Tank Drain Isolation Feedback	AI	0	100	Percent	-	-	-	-	-	J701	-
LALL-4230	LALL	4230	BFW	Feedwater Tank Level Transmitter Alarm Low, Low	CALC	22	-	Percent	-	-	-	-	-	J702	-
LAL-4230	LAL	4230	BFW	Feedwater Tank Level Transmitter Alarm Low	CALC	55	-	Percent	-	-	-	-	-	J702	-
LAH-4230	LAH	4230	BFW	Feedwater Tank Level Transmitter Alarm High	CALC	-	80	Percent	-	-	-	-	-	J702	-
LAHH-4230	LAHH	4230	BFW	Feedwater Tank Level Transmitter Alarm High, High	CALC	-	85	Percent	-	-	-	-	-	J702	-
PIT-4231	PIT	4231	BFW	Feedwater Tank Pressure Indicating Transmitter	Field	0	35	psig	Water	-	35	275	30	J702	J501/502
PI-4231	PI	4231	BFW	Feedwater Tank Pressure Indication	AI	0	35	psig	-	-	-	-	-	J702	-
PAH-4231	PAH	4231	BFW	Feedwater Tank Pressure Alarm High	CALC	-	15	Percent	-	-	-	-	-	J702	-
TI-4232	TI	4232	BFW	Feedwater Tank Local Temperature Indicator	Field	0	250	°F	Water	-	0	275	30	J702	J506/507
TE-4233	TE	4233	BFW	Feedwater Tank Temperature Element	Field	0	250	°F	Water	-	0	275	30	J702	J506/507
TI-4233	TI	4233	BFW	Feedwater Tank Temperature Indication	RTD	0	250	F	-	-	-	-	-	J702	-
LG-4234	LG	4234	BFW	Feedwater Tank Local Level Indicator	Field	0	132	Inches	Water	-	0	275	30	J702	J513
LSLL-4234	LSLL	4234	BFW	Feedwater Tank Level Switch Low Low	Field	20	-	Percent	Water	-	0	275	30	J702	J511/512
LY-4237	LY	4237	BFD	Feedwater Tank Drain Isolation Valve Positioner	Field	0	100	Percent	Water	-	35	230	30	J705	-
ZT-4237	ZT	4237	BFD	Feedwater Tank Drain Isolation Valve Position Transmitter	Field	-	-	-	-	-	-	-	-	J705	-
ZI-4237	ZI	4237	BFD	Feedwater Tank Drain Isolation Valve Position Indication	DI	-	-	-	-	-	-	-	-	J705	-
ZSC-4300	ZSC	4300	BFS	Boiler FW Pump 1 Inlet Isolation Valve Position Switch Closed	Field	-	-	-	-	-	-	-	-	J706	-
ZSO-4300	ZSO	4300	BFS	Boiler FW Pump 1 Inlet Isolation Valve Position Switch Opened	Field	-	-	-	-	-	-	-	-	J706	-
ZIC-4300	ZIC	4300	BFS	Boiler FW Pump 1 Inlet Isolation Valve Position Indication Closed	DI	-	-	-	-	-	-	-	-	J706	-
ZIO-4300	ZIO	4300	BFS	Boiler FW Pump 1 Inlet Isolation Valve Position Indication Opened	DI	-	-	-	-	-	-	-	-	J706	-
PIT-4304	PIT	4304	BFS	Boiler FW Pump 1 Inlet Pressure Indicating Transmitter	Field	0	40	psig	Water	6	35	274	100	J706	J501/502
PI-4304	PI	4304	BFS	Boiler FW Pump 1 Inlet Pressure Indication	AI	0	40	psig	-	-	-	-	-	J706	-
PDI-4304	PDI	4304	BFS	Boiler FW Pump 1 Differential Pressure Indication	CALC	0	570	psig	-	-	-	-	-	J706	-
PDAL-4304	PDAL	4304	BFS	Boiler FW Pump 1 Differential Pressure Alarm Low	CALC	480	-	psig	-	-	-	-	-	J706	-
PDAH-4304	PDAH	4304	BFS	Boiler FW Pump 1 Differential Pressure Alarm High	CALC	-	660	psig	-	-	-	-	-	J706	-
PIT-4305	PIT	4305	BFW	Boiler FW Pump 1 Outlet Pressure Indicating Transmitter	Field	0	1000	psig	Water	4	35	370	800	J706	J501/502

Balance of Plant Instrument List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	Fluid	Process Pipe Size	Temp Min (F)	Temp Max (F)	Press Max (psig)	P&ID DWG	Installation DWG
PI-4305	PI	4305	BFW	Boiler FW Pump 1 Outlet Pressure Indication	AI	0	1000	psig	-	-	-	-	-	J706	-
HS-4306	HS	4306	BFW	Boiler FW Pump 1 HOA Switch	Field	-	-	-	-	-	35	100	-	J706	-
XC-4306	XC	4306	BFW	Boiler FW Pump 1 Control Output	AO	0	100	Percent	-	-	-	-	-	J706	-
SI-4306	SI	4306	BFW	Boiler FW Pump 1 Speed Indication (From VFD)	AI	0	100	Percent	-	-	-	-	-	J706	-
YA-4306	YA	4306	BFW	Boiler FW Pump 1 Motor Fault Alarm (From VFD)	DI	-	-	-	-	-	-	-	-	J706	-
IT-4306	IT	4306	BFW	Boiler FW Pump 1 Current Transmitter	Field	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J706	-
II-4306	II	4306	BFW	Boiler FW Pump 1 Current Indication	AI	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J706	-
IAH-4306	IAH	4306	BFW	Boiler FW Pump 1 Current Alarm High	CALC	-	By Vendor	-	-	-	-	-	-	J706	-
TE-4306	TE	4306	BFW	Boiler FW Pump 1 Motor Temperature Element	Field	By Vendor	By Vendor	°F	-	-	-	-	-	J706	J506/507
TI-4306	TI	4306	BFW	Boiler FW Pump 1 Motor Temperature Indication	RTD	By Vendor	By Vendor	F	-	-	-	-	-	J706	-
TAH-4306	TAH	4306	BFW	Boiler FW Pump 1 Motor Temperature Alarm High	CALC	-	By Vendor	F	-	-	-	-	-	J706	-
VT-4306	VT	4306	BFW	Boiler FW Pump 1 Motor Vibration Transmitter	Field	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J706	-
VI-4306	VI	4306	BFW	Boiler FW Pump 1 Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J706	-
VAH-4306	VAH	4306	BFW	Boiler FW Pump 1 Motor Vibration Alarm High	CALC	-	By Vendor	-	-	-	-	-	-	J706	-
FIT-4308	FIT	4308	BFS	Boiler FW Pump 1 Flow Indicating Transmitter	Field	0	250,000	PPH	Water	6	35	274	100	J706	J514
FI-4308	FI	4308	BFS	Boiler FW Pump 1 Flow Indication (FIC-4308)	AI	0	250,000	PPH	-	-	-	-	-	J706	-
FC-4308	FC	4308	BFS	Boiler FW Pump 1 Flow Recirculation Control Output (FIC-4308)	AO	0	100	Percent	-	-	-	-	-	J706	-
FAL-4308	FAL	4308	BFS	Boiler FW Pump 1 Flow Alarm Low	CALC	50	-	-	-	-	-	-	-	J706	-
FY-4312	FY	4312	BFW	Boiler FW Pump 1 Recirculation Valve Positioner (from FIC-4308)	Field	0	100	Percent	-	-	-	-	-	J706	-
ZT-4312	ZT	4312	BFW	Boiler FW Pump 1 Recirculation Valve Position Transmitter	Field	0	100	Percent	-	-	-	-	-	J706	-
ZI-4312	ZI	4312	BFW	Boiler FW Pump 1 Recirculation Valve Position Indication	AI	0	100	Percent	-	-	-	-	-	J706	-
ZSC-4330	ZSC	4330	BFS	Boiler FW Pump 2 Inlet Isolation Valve Position Switch Closed	Field	-	-	-	-	-	-	-	-	J706	-
ZSO-4330	ZSO	4330	BFS	Boiler FW Pump 2 Inlet Isolation Valve Position Switch Opened	Field	-	-	-	-	-	-	-	-	J706	-
ZIC-4330	ZIC	4330	BFS	Boiler FW Pump 2 Inlet Isolation Valve Position Indication Closed	DI	-	-	-	-	-	-	-	-	J706	-
ZIO-4330	ZIO	4330	BFS	Boiler FW Pump 2 Inlet Isolation Valve Position Indication Opened	DI	-	-	-	-	-	-	-	-	J706	-
PIT-4334	PIT	4334	BFS	Boiler FW Pump 2 Inlet Pressure Indicating Transmitter	Field	0	40	psig	Water	6	35	274	100	J706	J501/502
PI-4334	PI	4334	BFS	Boiler FW Pump 2 Inlet Pressure Indicator	AI	0	40	psig	-	-	-	-	-	J706	-
PDI-4334	PDI	4334	BFS	Boiler FW Pump 2 Differential Pressure Indication	CALC	0	570	psig	-	-	-	-	-	J706	-
PDAL-4334	PDAL	4334	BFS	Boiler FW Pump 2 Differential Pressure Alarm Low	CALC	480	-	psig	-	-	-	-	-	J706	-
PDAH-4334	PDAH	4334	BFS	Boiler FW Pump 2 Differential Pressure Alarm High	CALC	-	660	psig	-	-	-	-	-	J706	-
PIT-4335	PIT	4335	BFW	Boiler FW Pump 2 Outlet Pressure Indicating Transmitter	Field	0	1000	psig	Water	4	35	370	800	J706	J501/502
PI-4335	PI	4335	BFW	Boiler FW Pump 2 Outlet Pressure Indication	AI	0	1000	psig	-	-	-	-	-	J706	-
HS-4336	HS	4336	BFW	Boiler FW Pump 2 HOA Switch	Field	-	-	-	-	-	35	100	-	J706	-
XC-4336	XC	4336	BFW	Boiler FW Pump 2 Control Output	AO	0	100	Percent	-	-	-	-	-	J706	-
SI-4336	SI	4336	BFW	Boiler FW Pump 2 Speed Indication (From VFD)	AI	0	100	Percent	-	-	-	-	-	J706	-
YA-4336	YA	4336	BFW	Boiler FW Pump 2 Motor Fault Alarm (From VFD)	DI	-	-	-	-	-	-	-	-	J706	-
IT-4336	IT	4336	BFW	Boiler FW Pump 2 Current Transmitter	Field	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J706	-
II-4336	II	4336	BFW	Boiler FW Pump 2 Current Indication	AI	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J706	-
IAH-4336	IAH	4336	BFW	Boiler FW Pump 2 Current Alarm High	CALC	-	By Vendor	-	-	-	-	-	-	J706	-
TE-4336	TE	4336	BFW	Boiler FW Pump 2 Motor Temperature Element	Field	By Vendor	By Vendor	°F	-	-	-	-	-	J706	J506/507
TI-4336	TI	4336	BFW	Boiler FW Pump 2 Motor Temperature Indication	RTD	By Vendor	By Vendor	F	-	-	-	-	-	J706	-
TAH-4336	TAH	4336	BFW	Boiler FW Pump 2 Motor Temperature Alarm High	CALC	-	By Vendor	F	-	-	-	-	-	J706	-
VT-4336	VT	4336	BFW	Boiler FW Pump 2 Motor Vibration Transmitter	Field	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J706	-
VI-4336	VI	4336	BFW	Boiler FW Pump 2 Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J706	-
VAH-4336	VAH	4336	BFW	Boiler FW Pump 2 Motor Vibration Alarm High	CALC	-	By Vendor	-	-	-	-	-	-	J706	-
FIT-4338	FIT	4338	BFS	Boiler FW Pump 2 Flow Indicating Transmitter	Field	0	250,000	PPH	Water	6	35	274	100	J706	J514
FI-4338	FI	4338	BFS	Boiler FW Pump 2 Flow Indication (FIC-4338)	AI	0	250,000	PPH	-	-	-	-	-	J706	-
FC-4338	FC	4338	BFS	Boiler FW Pump 2 Flow Recirculation Control Output (FIC-4338)	AO	0	100	Percent	-	-	-	-	-	J706	-
FAL-4338	FAL	4338	BFS	Boiler FW Pump 2 Flow Alarm Low	CALC	50	-	-	-	-	-	-	-	J706	-
FY-4342	FY	4342	BFW	Boiler FW Pump 2 Recirculation Valve Positioner (from FIC-4338)	Field	0	100	Percent	-	-	-	-	-	J706	-
ZT-4342	ZT	4342	BFW	Boiler FW Pump 2 Recirculation Valve Position Transmitter	Field	0	100	Percent	-	-	-	-	-	J706	-
ZI-4342	ZI	4342	BFW	Boiler FW Pump 2 Recirculation Valve Position Indication	AI	0	100	Percent	-	-	-	-	-	J706	-
ZSC-4360	ZSC	4360	BFS	Boiler FW Pump 3 Inlet Isolation Valve Position Switch Closed	Field	-	-	-	-	-	-	-	-	J706	-
ZSO-4360	ZSO	4360	BFS	Boiler FW Pump 3 Inlet Isolation Valve Position Switch Opened	Field	-	-	-	-	-	-	-	-	J706	-
ZIC-4360	ZIC	4360	BFS	Boiler FW Pump 3 Inlet Isolation Valve Position Indication Closed	DI	-	-	-	-	-	-	-	-	J706	-
ZIO-4360	ZIO	4360	BFS	Boiler FW Pump 3 Inlet Isolation Valve Position Indication Opened	DI	-	-	-	-	-	-	-	-	J706	-

Balance of Plant Instrument List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	Fluid	Process Pipe Size	Temp Min (F)	Temp Max (F)	Press Max (psig)	P&ID DWG	Installation DWG
PIT-4364	PIT	4364	BFS	Boiler FW Pump 3 Inlet Pressure Indicating Transmitter	Field	0	40	psig	Water	6	35	274	100	J706	J501/502
PI-4364	PI	4364	BFS	Boiler FW Pump 3 Inlet Pressure Indication	AI	0	40	psig	-	-	-	-	-	J706	-
PDI-4364	PDI	4364	BFS	Boiler FW Pump 3 Differential Pressure Indication	CALC	0	570	psig	-	-	-	-	-	J706	-
PDAL-4364	PDAL	4364	BFS	Boiler FW Pump 3 Differential Pressure Alarm Low	CALC	480	-	psig	-	-	-	-	-	J706	-
PDAH-4364	PDAH	4364	BFS	Boiler FW Pump 3 Differential Pressure Alarm High	CALC	-	660	psig	-	-	-	-	-	J706	-
PIT-4365	PIT	4365	BFW	Boiler FW Pump 3 Outlet Pressure Indicating Transmitter	Field	0	1000	psig	Water	4	35	370	800	J706	J501/502
PI-4365	PI	4365	BFW	Boiler FW Pump 3 Outlet Pressure Indication	AI	0	1000	psig	-	-	-	-	-	J706	-
HS-4366	HS	4366	BFW	Boiler FW Pump 3 HOA Switch	Field	-	-	-	-	-	35	100	-	J706	-
XC-4366	XC	4366	BFW	Boiler FW Pump 3 Control Output	AO	0	100	Percent	-	-	-	-	-	J706	-
SI-4366	SI	4366	BFW	Boiler FW Pump 3 Speed Indication (From VFD)	AI	0	100	Percent	-	-	-	-	-	J706	-
YA-4366	YA	4366	BFW	Boiler FW Pump 3 Motor Fault Alarm (From VFD)	DI	-	-	-	-	-	-	-	-	J706	-
IT-4366	IT	4366	BFW	Boiler FW Pump 3 Current Transmitter	Field	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J706	-
II-4366	II	4366	BFW	Boiler FW Pump 3 Current Indication	AI	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J706	-
IAH-4366	IAH	4366	BFW	Boiler FW Pump 3 Current Alarm High	CALC	-	By Vendor	-	-	-	-	-	-	J706	-
TE-4366	TE	4366	BFW	Boiler FW Pump 3 Motor Temperature Element	Field	By Vendor	By Vendor	°F	-	-	-	-	-	J706	J506/507
TI-4366	TI	4366	BFW	Boiler FW Pump 3 Motor Temperature Indication	RTD	By Vendor	By Vendor	F	-	-	-	-	-	J706	-
TAH-4366	TAH	4366	BFW	Boiler FW Pump 3 Motor Temperature Alarm High	CALC	-	By Vendor	F	-	-	-	-	-	J706	-
VT-4366	VT	4366	BFW	Boiler FW Pump 3 Motor Vibration Transmitter	Field	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J706	-
VI-4366	VI	4366	BFW	Boiler FW Pump 3 Motor Vibration Indication	AI	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J706	-
VAH-4366	VAH	4366	BFW	Boiler FW Pump 3 Motor Vibration Alarm High	CALC	-	By Vendor	-	-	-	-	-	-	J706	-
FIT-4368	FIT	4368	BFS	Boiler FW Pump 3 Flow Indicating Transmitter	Field	0	250,000	PPH	Water	6	35	274	100	J706	J514
FI-4368	FI	4368	BFS	Boiler FW Pump 3 Flow Indication (FIC-4368)	AI	0	250,000	PPH	-	-	-	-	-	J706	-
FC-4368	FC	4368	BFS	Boiler FW Pump 3 Flow Recirculation Control Output (FIC-4368)	AO	0	100	Percent	-	-	-	-	-	J706	-
FAL-4368	FAL	4368	BFS	Boiler FW Pump 3 Flow Alarm Low	CALC	50	-	-	-	-	-	-	-	J706	-
FY-4372	FY	4372	BFW	Boiler FW Pump 3 Recirculation Valve Positioner (from FIC-4368)	Field	0	99	Percent	-	-	-	-	-	J706	-
ZT-4372	ZT	4372	BFW	Boiler FW Pump 3 Recirculation Valve Position Transmitter	Field	0	100	Percent	-	-	-	-	-	J706	-
ZI-4372	ZI	4372	BFW	Boiler FW Pump 3 Recirculation Valve Position Indication	AI	0	100	Percent	-	-	-	-	-	J706	-
LG-4401	LG	4401	Sulfite	Sulfite Tank Level Gauge	Field	0	By Vendor	Inches	Sulfite	-	35	100	atm	J703	J513
HS-4405	HS	4405	Sulfite	Sulfite Pump CFP-1 HOA Switch	Field	-	-	-	-	-	35	100	-	J703	-
SC-4405	SC	4405	Sulfite	Sulfite Pump CFP-1 Control Output	AO	Field Exp	Field Exp	Field Exp	-	-	-	-	-	J703	-
ST-4405	ST	4405	Sulfite	Sulfite Pump CFP-1 Speed Transmitter	Field	Field Exp	Field Exp	Field Exp	-	-	35	100	-	J703	-
SI-4405	SI	4405	Sulfite	Sulfite Pump CFP-1 Speed Indication	AI	Field Exp	Field Exp	Field Exp	-	-	-	-	-	J703	-
PIT-4406	PIT	4406	Sulfite	Sulfite Pump CFP-1 Outlet Pressure Indicating Transmitter	Field	0	40	psig	Sulfite	0.25	35	100	-	J703	J501/502
PI-4406	PI	4406	Sulfite	Sulfite Pump CFP-1 Outlet Pressure Indication	AI	0	40	psig	-	-	-	-	-	J703	-
LG-4421	LG	4421	Filming Amin	Filming Amine Tank Level Gauge	Field	0	By Vendor	Inches	Filming Amine	-	35	100	atm	J703	J513
HS-4425	HS	4425	Filming Amin	Filming Amine Pump CFP-2A to FW Tank HOA Switch	Field	-	-	-	-	-	35	100	-	J703	-
SC-4425	SC	4425	Filming Amin	Filming Amine Pump CFP-2A to FW Tank Control Output	AO	Field Exp	Field Exp	Field Exp	-	-	-	-	-	J703	-
ST-4425	ST	4425	Filming Amin	Filming Amine Pump CFP-2A to FW Tank Speed Transmitter	Field	Field Exp	Field Exp	Field Exp	-	-	35	100	-	J703	-
SI-4425	SI	4425	Filming Amin	Filming Amine Pump CFP-2A to FW Tank Speed Indication	AI	Field Exp	Field Exp	Field Exp	-	-	-	-	-	J703	-
PIT-4426	PIT	4426	Filming Amin	Filming Amine Pump CFP-2A Outlet Pressure Indicating Transmitter	Field	0	40	psig	Filming Amine	0.25	35	100	-	J703	J501/502
PI-4426	PI	4426	Filming Amin	Filming Amine Pump CFP-2A Outlet Pressure Indication	AI	0	40	psig	-	-	-	-	-	J703	-
HS-4435	HS	4435	Filming Amin	Filming Amine Pump CFP-2B to Steam Line HOA Switch	Field	-	-	-	-	-	35	100	-	J703	-
SC-4435	SC	4435	Filming Amin	Filming Amine Pump CFP-2B to Steam Line Control Output	AO	Field Exp	Field Exp	Field Exp	-	-	-	-	-	J703	-
ST-4435	ST	4435	Filming Amin	Filming Amine Pump CFP-2B to Steam Line Speed Transmitter	Field	Field Exp	Field Exp	Field Exp	-	-	35	100	-	J703	-
SI-4435	SI	4435	Filming Amin	Filming Amine Pump CFP-2B to Steam Line Speed Indication	AI	-	-	-	-	-	-	-	-	J703	-
PIT-4436	PIT	4436	Filming Amin	Filming Amine Pump CFP-2B Outlet Pressure Indicating Transmitter	Field	0	750	psig	Filming Amine	0.25	35	100	-	J703	J501/502
PI-4436	PI	4436	Filming Amin	Filming Amine Pump CFP-2B Outlet Pressure Indication	AI	0	750	psig	-	-	-	-	-	J703	-
LG-4441	LG	4441	Phosphate	Phosphate Tank Level Gauge	Field	0	By Vendor	Inches	Phosphate	-	35	100	atm	J703	J513
HS-4445	HS	4445	Phosphate	Phosphate Pump CFP-3A HOA Switch	Field	-	-	-	-	-	35	100	-	J703	-
SC-4445	SC	4445	Phosphate	Phosphate Pump CFP-3A Control Output	AO	Field Exp	Field Exp	Field Exp	-	-	-	-	-	J703	-
ST-4445	ST	4445	Phosphate	Phosphate Pump CFP-3A Speed Transmitter	Field	Field Exp	Field Exp	Field Exp	-	-	35	100	-	J703	-
SI-4445	SI	4445	Phosphate	Phosphate Pump CFP-3A Speed Indication	AI	Field Exp	Field Exp	Field Exp	-	-	-	-	-	J703	-
PIT-4446	PIT	4446	Phosphate	Phosphate Pump CFP-3A Outlet Pressure Indicating Transmitter	Field	0	750	psig	Phosphate	0.25	35	100	-	J703	J501/502
PI-4446	PI	4446	Phosphate	Phosphate Pump CFP-3A Outlet Pressure Indication	AI	0	750	psig	-	-	-	-	-	J703	-
HS-4455	HS	4455	Phosphate	Phosphate Pump CFP-3B HOA Switch	Field	-	-	-	-	-	35	100	-	J703	-
SC-4455	SC	4455	Phosphate	Phosphate Pump CFP-3B Control Output	AO	Field Exp	Field Exp	Field Exp	-	-	-	-	-	J703	-

Balance of Plant Instrument List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	Fluid	Process Pipe Size	Temp Min (F)	Temp Max (F)	Press Max (psig)	P&ID DWG	Installation DWG
ST-4455	ST	4455	Phosphate	Phosphate Pump CFP-3B Speed Transmitter	Field	Field Exp	Field Exp	Field Exp	-	-	35	100	-	J703	-
SI-4455	SI	4455	Phosphate	Phosphate Pump CFP-3B Speed Indication	AI	Field Exp	Field Exp	Field Exp	-	-	-	-	-	J703	-
PIT-4456	PIT	4456	Phosphate	Phosphate Pump CFP-3B Outlet Pressure Indicating Transmitter	Field	0	750	psig	Phosphate	0.25	35	100	-	J703	J501/502
PI-4456	PI	4456	Phosphate	Phosphate Pump CFP-3B Outlet Pressure Indication	AI	0	750	psig	-	-	-	-	-	J703	-
LG-4461	LG	4461	NL-90	NL-90 Tank Level Gauge	Field	0	By Vendor	Inches	NL-90	-	35	100	atm	J703	J513
HS-4465	HS	4465	NL-90	NL-90 Pump CFP-4A Pump HOA Switch	Field	-	-	-	-	-	35	100	-	J703	-
SC-4465	SC	4465	NL-90	NL-90 Pump CFP-4A Control Output	AO	Field Exp	Field Exp	Field Exp	-	-	-	-	-	J703	-
ST-4465	ST	4465	NL-90	NL-90 Pump CFP-4A Speed Transmitter	Field	Field Exp	Field Exp	Field Exp	-	-	35	100	-	J703	-
SI-4465	SI	4465	NL-90	NL-90 Pump CFP-4A Speed Indication	AI	Field Exp	Field Exp	Field Exp	-	-	-	-	-	J703	-
PIT-4466	PIT	4466	NL-90	NL-90 Pump CFP-4A Outlet Pressure Indicating Transmitter	Field	0	750	psig	NL-90	0.25	35	100	-	J703	J501/502
PI-4466	PI	4466	NL-90	NL-90 Pump CFP-4A Outlet Pressure Indication	AI	0	750	psig	-	-	-	-	-	J703	-
HS-4475	HS	4475	NL-90	NL-90 Pump CFP-4B HOA Switch	Field	-	-	-	-	-	35	100	-	J703	-
SC-4475	SC	4475	NL-90	NL-90 Pump CFP-4B Control Output	AO	Field Exp	Field Exp	Field Exp	-	-	-	-	-	J703	-
ST-4475	ST	4475	NL-90	NL-90 Pump CFP-4B Speed Transmitter	Field	Field Exp	Field Exp	Field Exp	-	-	35	100	-	J703	-
SI-4475	SI	4475	NL-90	NL-90 Pump CFP-4B Speed Indication	AI	Field Exp	Field Exp	Field Exp	-	-	-	-	-	J703	-
PIT-4476	PIT	4476	NL-90	NL-90 Pump CFP-4B Outlet Pressure Indicating Transmitter	Field	0	750	psig	NL-90	0.25	35	100	-	J703	J501/502
PI-4476	PI	4476	NL-90	NL-90 Pump CFP-4B Outlet Pressure Indication	AI	0	750	psig	-	-	-	-	-	J703	-
FQIT-5111	FQIT	5111	HPS	Boiler 1 Steam Flow Indicating Transmitter w/ Totalizer	Field	0	150	KPPH	Steam	6	35	750	665	J709	J514
FI-5111	FI	5111	HPS	Boiler 1 Steam Flow Indication	AI	0	150	KPPH	-	-	-	-	-	J709	-
FQI-5111	FQI	5111	HPS	Boiler 1 Steam Flow Totalizer Indication	AI	0	1,000,000	Kilo-Pounds	-	-	-	-	-	J709	-
FQIT-5311	FQIT	5311	HPS	Boiler 2 Steam Flow Indicating Transmitter w/ Totalizer	Field	0	150	KPPH	Steam	6	35	750	665	J711	J514
FI-5311	FI	5311	HPS	Boiler 2 Steam Flow Indication	AI	0	150	KPPH	-	-	-	-	-	J711	-
FQI-5311	FQI	5311	HPS	Boiler 2 Steam Flow Totalizer Indication	AI	0	1,000,000	Kilo-Pounds	-	-	-	-	-	J711	-
FQIT-5511	FQIT	5511	HPS	Boiler 3 Steam Flow Indicating Transmitter w/ Totalizer	Field	0	150	KPPH	Steam	6	35	750	665	J713	J514
FI-5511	FI	5511	HPS	Boiler 3 Steam Flow Indication	AI	0	150	KPPH	-	-	-	-	-	J713	-
FQI-5511	FQI	5511	HPS	Boiler 3 Steam Flow Totalizer Indication	AI	0	1,000,000	Kilo-Pounds	-	-	-	-	-	J713	-
PI-5601	PI	5601	AHW	Auxiliary Steam Boiler Pressure Indication	Field	-	-	-	-	-	-	-	-	J702	-
LG-5603	LG	5603	AHW	Auxiliary Steam Boiler Level Gauge (Sight Glass)	Field	0	By Vendor	Inches	Water	-	35	By Vendor	By Vendor	J702	J513
HS-5620	HS	5620	AHW	Auxiliary Hot Water Pump BFP-4 HOA Switch	Field	-	-	-	-	-	35	100	-	J702	-
PIT-5623	PIT	5623	AHW	Auxiliary Hot Water Pump BFP-4 Inlet Pressure Indicating Transmitter	Field	0	40	psig	Water	-	35	250	160	J702	J501/502
PI-5623	PI	5623	AHW	Auxiliary Hot Water Pump BFP-4 Inlet Pressure Indication	AI	0	40	psig	-	-	-	-	-	J702	-
PIT-5624	PIT	5624	AHW	Auxiliary Hot Water Pump BFP-4 Outlet Pressure Indicating Transmitter	Field	0	1000	psig	Water	-	35	250	160	J702	J501/502
PI-5624	PI	5624	AHW	Auxiliary Hot Water Pump BFP-4 Outlet Pressure Indication	AI	0	1000	psig	-	-	-	-	-	J702	-
TI-5629	TI	5629	AHW	Auxiliary Steam Boiler Local Temperature Indicator	Field	0	500	°F	Steam	-	35	By Vendor	By Vendor	J702	J501/502
LG-5710	LG	5710	CBD	Continuous Blowdown Tank Level Gauge (Sight Glass)	Field	0	100	Percent	Water	-	35	350	150	J704	J513
LT-5710	LT	5710	CBD	Continuous Blowdown Tank Level Transmitter	Field	0	100	Percent	Water	-	35	350	150	J704	J509/510
LI-5710	LI	5710	CBD	Continuous Blowdown Tank Level Indication (LIC-5710)	AI	0	100	Percent	-	-	-	-	-	J704	-
LC-5710	LC	5710	CBD	Continuous Blowdown Tank Level Control Output (LIC-5710)	AO	0	100	Percent	-	-	-	-	-	J704	-
LAH-5710	LAH	5710	CBD	Continuous Blowdown Tank Level Alarm High	CALC	0	100	Percent	-	-	-	-	-	J704	-
LY-5710	LY	5710	CBD	Intermittent Blowdown Level Control Valve Positioner	Field	-	-	-	-	-	-	-	-	J705	-
ZT-5710	ZT	5710	CBD	Intermittent Blowdown Level Control Valve Position Transmitter	Field	0	100	Percent	-	-	-	-	-	J705	-
ZI-5710	ZI	5710	CBD	Intermittent Blowdown Level Control Valve Position Indication	AI	-	-	-	-	-	-	-	-	J705	-
FSL-5711	FSL	5711	CBD	Intermittent Blowdown Level Control Flow Switch	Field	By Vendor	-	GPM	Water	1.5	35	100	100	J704	J515
FAL-5711	FAL	5711	CBD	Intermittent Blowdown Level Control Flow Alarm Low	DI	By Vendor	-	GPM	-	-	-	-	-	J704	-
PI-5713	PI	5713	CBD	Continuous Blowdown Tank Local Pressure Indicator	Field	0	15	psig	Water	-	35	350	150	J704	J503
TI-5715	TI	5715	CBD	Continuous Blowdown Tank Outlet Local Temperature Indicator	Field	0	400	°F	Water	2	35	350	150	J704	J506/507
HS-5717	HS	5717	CBD	Continuous Blowdown Pump HXP-3 HOA Switch	Field	-	-	-	-	-	35	100	-	J704	-
XC-5717	XC	5717	CBD	Continuous Blowdown Pump HXP-3 Control Output	DO	-	-	-	-	-	-	-	-	J704	-
YS-5717	YS	5717	CBD	Continuous Blowdown Pump HXP-3 Running Switch	Field	-	-	-	-	-	-	-	-	J704	-
YI-5717	YI	5717	CBD	Continuous Blowdown Pump HXP-3 Running Indication	DI	-	-	-	-	-	-	-	-	J704	-
IT-5717	IT	5717	CBD	Continuous Blowdown Pump HXP-3 Current Transmitter	Field	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J704	-
II-5717	II	5717	CBD	Continuous Blowdown Pump HXP-3 Current Indication	AI	By Vendor	By Vendor	By Vendor	-	-	-	-	-	J704	-
IAL-5717	IAL	5717	CBD	Continuous Blowdown Pump HXP-3 Current Alarm High	CALC	-	By Vendor	-	-	-	-	-	-	J704	-
IAH-5717	IAH	5717	CBD	Continuous Blowdown Pump HXP-3 Current Alarm High	CALC	-	By Vendor	-	-	-	-	-	-	J704	-
PI-5720	PI	5720	CBD	Blowdown Heat Recovery Inlet Local Pressure Indicator	Field	0	15	psig	Water	-	35	275	150	J704	J503
PI-5721	PI	5721	CBD	Blowdown Heat Recovery Outlet Local Pressure Indicator	Field	0	15	psig	Water	-	35	275	150	J704	J503

Balance of Plant Instrument List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	Fluid	Process Pipe Size	Temp Min (F)	Temp Max (F)	Press Max (psig)	P&ID DWG	Installation DWG
LG-5730	LG	5730	IBD	Intermittent Blowdown Tank Level Gauge (Sight Glass)	Field	0	100	Percent	Water	-	35	100	1	J705	J513
TI-5731	TI	5731	IBD	Intermittent Blowdown Tank Local Temperature	Field	0	120	°F	Water	-	35	100	1	J705	J506/507
PI-5806	PI	5806	SVS	SVS Pressure Reducing Station Local Pressure Indicator	Field	0	550	psig	Steam	10	35	470	500	J707	J503
PT-5807	PT	5807	SVS	SVS Pressure Reducing Station Pressure Transmitter	Field	0	550	psig	Steam	10	35	470	500	J707	J501/502
PI-5807	PI	5807	SVS	SVS Pressure Reducing Station Pressure Indication (PIC-5807)	AI	0	550	psig	-	-	-	-	-	J707	-
PC-5807	PC	5807	SVS	SVS Pressure Reducing Station Pressure Control Output (PIC-5807)	AO	0	100	Percent	-	-	-	-	-	J707	-
PY-5807	PY	5807	HPS	SVS Pressure Reducing Station Pressure Control Valve Positioner (PIC-5807)	Field	0	100	Percent	-	-	-	-	-	J707	-
FQIT-5823	FQIT	5823	HPS	Steam Recirculation Flow Transmitter w/Totalizer	Field	0	70,000	PPH	Steam	4	35	470	500	J707	J514
FI-5823	FI	5823	HPS	Steam Recirculation Flow Indication	AI	0	70,000	PPH	-	-	-	-	-	J707	-
FQI-5823	FQI	5823	HPS	Steam Recirculation Flow Totalizer	AI	0	1,000,000	CF	-	-	-	-	-	J707	-
PY-5830	PY	5830	HPS	Steam Recirculation Pressure Control Positioner (PIC-5842)	Field	0	100	Percent	-	-	-	-	-	J707	-
PI-5832	PI	5832	AUX	Steam Recovery to Deaerator Local Pressure Indicator	Field	0	20	psig	Steam	8	35	230	7	J707	J503
PI-6601	PI	6601	NH3	Anhydrous Ammonia Tank Local Pressure Indicator	Field	0	300	psig	NH3	-	35	100	265	J715	J503
LI-6602	LI	6602	NH3	Anhydrous Ammonia Tank Local Level Indicator	Field	0	100	Percent	NH3	-	35	100	265	J715	-
PI-6604	PI	6604	NH3	Anhydrous Ammonia Tank Relief Valve Discharge Line Local Pressure Indication	Field	-	-	-	NH3	-	35	100	265	J715	-
PS-6604	PS	6604	NH3	Anhydrous Ammonia Tank Relief Valve Discharge Line Pressure Switch	Field	-	25	psig	NH3	-	35	100	265	J715	-
PAH-6604	PAH	6604	NH3	Anhydrous Ammonia Tank Relief Valve Discharge Line Pressure Alarm High	DI	-	25	psig	-	-	-	-	-	J715	-
LT-6606	LT	6606	NH3	Anhydrous Ammonia Tank Level Transmitter	Field	0	100	Percent	NH3	-	35	100	265	J715	J509/510
LI-6606	LI	6606	NH3	Anhydrous Ammonia Tank Level Indicator	AI	0	100	Percent	-	-	-	-	-	J715	-
ZSC-6609	ZSC	6609	NH3	Anhydrous Ammonia 3/4" Line Emergency Valve Feedback Switch Closed	Field	-	-	-	-	-	-	-	-	J715	-
ZIC-6609	ZIC	6609	NH3	Anhydrous Ammonia 3/4" Line Emergency Valve Feedback Indication Closed	DI	-	-	-	-	-	-	-	-	J715	-
ZLC-6609	ZLC	6609	NH3	Anhydrous Ammonia 3/4" Line Emergency Valve Feedback Closed Light	Field	-	-	-	-	-	-	-	-	J715	-
HS-6610	HS	6610	NH3	Anhydrous Ammonia 3/4" Line Isolation Valve On/Off Control Output	DO	-	-	-	-	-	-	-	-	J715	-
ZSC-6610	ZSC	6610	NH3	Anhydrous Ammonia 3/4" Line Isolation Valve Feedback Switch Closed	Field	-	-	-	-	-	-	-	-	J715	-
ZIC-6610	ZIC	6610	NH3	Anhydrous Ammonia 3/4" Line Isolation Valve Feedback Indication Closed	DI	-	-	-	-	-	-	-	-	J715	-
TI-6620	TI	6620	NH3	Ammonia Diffusion Tank Local Temperature Indication	Field	0	200	°F	NH3 in Water	-	35	160	-	J715	J506/507
TE-6621	TE	6621	NH3	Ammonia Diffusion Tank Temperature Element	Field	0	200	°F	NH3 in Water	-	35	160	-	J715	J506/507
TI-6621	TI	6621	NH3	Ammonia Diffusion Tank Temperature Indication	RTD	0	200	°F	-	-	-	-	-	J715	-
TAH-6621	TAH	6621	NH3	Ammonia Diffusion Tank Temperature Alarm High	CALC	-	80	°F	-	-	-	-	-	J715	-
TAHH-6621	TAHH	6621	NH3	Ammonia Diffusion Tank Temperature Alarm High-High	CALC	-	100	°F	-	-	-	-	-	J715	-
TKA-6621	TKA	6621	NH3	Ammonia Diffusion Tank Temperature Rate-Of-Change Alarm (2 min average)	CALC	-	1	F°/min	-	-	-	-	-	J715	-
LG-6622	LG	6622	NH3	Ammonia Diffusion Tank Level Gauge (Sight Glass)	Field	0	100	Percent	NH3 in Water	-	35	160	48" H2O	J715	J513
HS-6630	HS	6630	NH3	NH3 Emergency Switch (N231 Control Room)	Field	-	-	-	-	-	35	100	-	J715	-
HS-6631	HS	6631	NH3	NH3 Emergency Switch (Boiler Plant, Near N231 High-Bay Entrance)	Field	-	-	-	-	-	35	100	-	J715	-
HS-6632	HS	6632	NH3	NH3 Emergency Switch (Boiler Plant, Near NW Emergency Exit Man-Gate)	Field	-	-	-	-	-	35	100	-	J715	-
HS-6633	HS	6633	NH3	NH3 Emergency Switch (Outside Boiler Plant NE Man-Gate)	Field	-	-	-	-	-	35	100	-	J715	-
HS-6634	HS	6634	NH3	NH3 Emergency Alarm - Control Room Buzzer Silence	Field	-	-	-	-	-	35	100	-	J715	-
HS-6635	HS	6635	NH3	NH3 Emergency Alarm - Boiler Plant Horn Silence (Button in Control Room)	Field	-	-	-	-	-	35	100	-	J715	-
UA-6636	UA	6636	NH3	NH3 Emergency Alarm - Control Room Light and Buzzer	Field	-	-	-	-	-	35	100	-	J715	-
UA-6637	UA	6637	NH3	NH3 Emergency Alarm - N231 High-Bay Flashing Beacon	Field	-	-	-	-	-	35	100	-	J715	-
UA-6638	UA	6638	NH3	NH3 Emergency Alarm - Central Boiler Plant Flashing Beacon and Horn	Field	-	-	-	-	-	35	100	-	J715	-
UA-6639	UA	6639	NH3	NH3 Emergency Alarm - North-East Boiler Plant Flashing Beacon	Field	-	-	-	-	-	35	100	-	J715	-
PI-6741	PI	6741	A	Shop Air From N231 Receiver Tank Local Pressure Indicator	Field	0	180	psig	Air	1.5	35	100	180	J714	J503
PT-6742	PT	6742	A	Shop Air From N231 Receiver Tank Pressure Transmitter	Field	0	180	psig	Air	1.5	35	100	180	J714	J501/502
PI-6742	PI	6742	A	Shop Air From N231 Receiver Tank Pressure Indication	AI	0	180	psig	-	-	-	-	-	J714	-
PAL-6742	PAL	6742	A	Shop Air From N231 Receiver Tank Pressure Alarm Low	CALC	85	-	psig	-	-	-	-	-	J714	-
PI-6751	PI	6751	IA	Instrument Air From N229A Receiver Tank Local Pressure Indicator	Field	0	180	psig	Air	1.5	35	100	180	J714	J503
PT-6752	PT	6752	IA	Instrument Air From N229A Receiver Tank Pressure Transmitter	Field	0	180	psig	Air	1.5	35	100	180	J714	J501/502
PI-6752	PI	6752	IA	Instrument Air From N229A Receiver Tank Pressure Indication	AI	0	180	psig	-	-	-	-	-	J714	-
PAL-6752	PAL	6752	IA	Instrument Air From N229A Receiver Tank Pressure Alarm Low	CALC	85	-	psig	-	-	-	-	-	J714	-

Balance of Plant Instrument List

Tagname	Prefix	Number	Service	Description	Type or I/O Type	Scale Low	Scale High	Units	Fluid	Process Pipe Size	Temp Min (F)	Temp Max (F)	Press Max (psig)	P&ID DWG	Installation DWG

"**Service**" Abbreviations:	
A	Air (Shop)
AHW	Auxiliary Hot Water
AUX	Auxiliary Steam to Deaerator Tank
BFD	Boiler Feedwater Drain
BFS	Boiler Feedwater Suction
BFW	Boiler Feedwater
CBD	Continuous Blowdown
DA	Draft Air
G	Gas (Reduced Pressure Natural Gas)
HPS	High Pressure Steam
IA	Instrument Air
IBD	Intermittent Blowdown
IW	Industrial Waste (Water)
LPS	Low Pressure Steam
MPG	Medium Pressure Gas (Natural Gas)
MU	Make-Up Water
NH3	Ammonia
RO	Reverse Osmosis Water
SCW	Softened Cold Water
SPW	Soft Preheated Water
SVS	Steam Vacuum System

Points	
76	Analog Inputs
18	Analog Outputs
29	Digital Inputs
5	Digital Outputs
5	RTD Inputs

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Appendix D

INSTRUMENT DATA SHEETS

National Aeronautics and Space Administration Ames Research Center

Ammonia/Monochloramine

Water Analyzer Instrument

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
AIT-4083			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: **SVS Boiler Replacement**

TAG NO:	**AIT-4083**	Hookup Drawings:	J516	Loop Wiring Diagrams:							
		Spec No:	40 9500	Line / Vessel Number:	N/A						<-
Asset No:		P&ID:	J701	Line ID:	6.07	Size:	6	Schedule:	40		<-
Service Description:	Water Softener Outlet Hardness Analyzer Indicating Transmitter			Manufacturer:							<-
				Model:							<-
Safety Class	GS			Quality Assurance Level							<-

PROCESS CONDITIONS

Pressure:						Units	Fluid:	Water					
Oper:	40	Design:	1	H2OTst:	N/A	atm	Area Classification:	N/A					Units
Temperature:							Ambient Temperature	Min:	35	Max:	100		F
Min:	35	Normal:	75	Max:	125	deg F	Service:	SCW		Critical:	N/A		
Flow:							pH:						Units
Min:	N/A	Normal:	213,000	Max:	500,000	PPH	Min:		Normal:		Max:		

ELEMENT

Tag Name:	AIT-4083	SS Tag:	Yes
Type:			
Process Connection:			
Electrical Connection:			
Isothermal Point:			
Max Pressure Rating:		Max temperature:	
Body Material:		Electrode Material:	
Insulation Material		O-ring Material:	
90% Temp resp		Temp Element:	
Element Diameter			
Element Length:			
Immersion Length:			
Manufacturer:			
Model:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Smart:	No	Indicate:	Yes	Isolate:	No
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	5
Ambient Temperature Compensation:	Yes				
Factory Calibration:	Yes				
Comp Algorithm:					
Conduit Connection:					
Operating Temp:		Humidity:			
Body Material:					
SS Tag:	Yes				
Accuracy:		Calibrated Range:			

FITTING SUBASSEMBLY

Type:			
Assy Length:			
Assy Diameter:			
Assy Material:		O-ring Material	
Process Connection:			
Signal Connection:			
Manufacturer:			
Model:			

CONNECTING HEAD

Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	5
Material:					
Style:					
Sensor Connection:					
Conduit Connection:					
Termination Strip:					
Manufacturer:					
Model:					

NOTES

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Vortex
Flow Instrument

DATA SHEET NO.	REV.
FIT-4308	0

SHEET	OF	DATE
1	1	12-12-2012

BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project: **SVS Boiler Replacement**

TAG NO:	**FIT-4308**	Hookup Drawings:	J514	Loop Wiring Diagram:						rev <-
		Spec:	40 9500	Line / Vessel Number:	N/A					<-
Asset No:		P&ID:	J706	Line ID:	6.07	Size:	6	Schedule:	40	<-
Service Description:	Boiler FW Pump 1 Flow Indicating Transmitter			Manufacturer:	Sierra Instruments					<-
				Model:	240/241					<-
Safety Class	GS			Quality Assurance Level						<-

PROCESS CONDITIONS

Fluid:	Water		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	Liquid			Min:	0	PPH	N/A	N/A	N/A	N/A
Compressibility (Z):	N/A	Units:		Normal (Operating):	126,000		N/A		N/A	
Temperature @ Operating:	75	deg F		Max (Full Scale):	250000		N/A		N/A	
Pressure @ Operating:	40	psig		SG/Density @ Operating:		lbm / in^3	N/A	N/A		
Vapor Pressure:	No			Viscosity @ Operating:	N/A			N/A		
Base Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):	N/A		% Solids:	N/A		
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	SS		
Flange Material:	SS			Flange Rating	ANSI Class 600#					

FLOW TUBE

Process Conenction					
Tube Material	316SS	Liner Material			
Element Type	Shedder Bar	Electrode Material			
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Grounding Type:		Grounding Material:			
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protoco:	HART	Location:	Remote		
Max Flow(gpm)		Normal:	N/A	Minimum	
Max Temp (deg F)		Minimum			
Max Press (psi)	Flange Rating	Minimum			
Max velocity (ft/s)	33	Min Cond (uS/cm)	N/A		
Vacuum Possibility	No				

CONVERTER

Voltage:					
Power Wiring:		Signal Type:	4 - 20 mA		
Communication Protoco:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Pulse Frequency (pps)	N/A				
Operating temp (deg F)					
Calibrated Span (gpm):					
Factory Calibration:	Yes				
Body Material:					
SS Tag:	FIT-4308				
Accuracy:	0.75% reading				
Alarms	qty 1 dry contact	Rating	30VDC or 120mA		
Status	qty 2 dry contact	Rating	30VDC or 120mA		
Mounting	Flush Panel				

NOTES

With Totalizer

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Vortex
Flow Instrument

DATA SHEET NO.	REV.
FIT-4338	0

SHEET	OF	DATE
1	1	12-12-2012

BY	CHK'D	PROC.	APPR.
NCC	AME		

NO.	BY	DATE	REVISION

P.O.	
REQ.	

Project: **SVS Boiler Replacement**

TAG NO:	**FIT-4338**	Hookup Drawings:	J514	Loop Wiring Diagram:						<-
		Spec:	40 9500	Line / Vessel Number:	N/A					<-
Asset No:		P&ID:	J706	Line ID:	6.07	Size:	6	Schedule:	40	<-
Service Description:	Boiler FW Pump 2 Flow Indicating Transmitter			Manufacturer:	Sierra Instruments					<-
				Model:	240/241					<-
Safety Class	GS			Quality Assurance Level						<-

PROCESS CONDITIONS

Fluid:	Water		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:	<-
Fluid State Present:	Liquid			Min:	0	PPH	N/A	N/A	N/A	N/A	<-
Compressibility (Z):	N/A	Units:		Normal (Operating):	126,000		N/A		N/A		<-
Temperature @ Operating:	75	deg F		Max (Full Scale):	250000		N/A		N/A		<-
Pressure @ Operating:	40	psig		SG/Density @ Operating:		lbm / in^3	N/A	N/A			<-
Vapor Pressure:	No			Viscosity @ Operating:	N/A			N/A			<-
Base Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):	N/A		% Solids:	N/A			<-
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	SS			<-
Flange Material:	SS			Flange Rating	ANSI Class 600#						<-

FLOW TUBE

Process Conenction					
Tube Material	316SS	Liner Material			
Element Type	Shedder Bar	Electrode Material			
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Grounding Type:		Grounding Material:			
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protoco:	HART	Location:	Remote		
Max Flow(gpm)		Normal:	N/A	Minimum	
Max Temp (deg F)		Minimum			
Max Press (psi)	Flange Rating	Minimum			
Max velocity (ft/s)	33	Min Cond (uS/cm)	N/A		
Vacuum Possibility	No				

CONVERTER

Voltage:					
Power Wiring:		Signal Type:	4 - 20 mA		
Communication Protoco:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Pulse Frequency (pps)	N/A				
Operating temp (deg F)					
Calibrated Span (gpm):					
Factory Calibration:	Yes				
Body Material:					
SS Tag:	FIT-4338				
Accuracy:	0.75% reading				
Alarms	qty 1 dry contact	Rating	30VDC or 120mA		
Status	qty 2 dry contact	Rating	30VDC or 120mA		
Mounting	Flush Panel				

NOTES

With Totalizer

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Vortex
Flow Instrument

DATA SHEET NO.	REV.
FIT-4368	0

SHEET	OF	DATE
1	1	12-12-2012

BY	CHK'D	PROC.	APPR.
NCC	AME		

NO.	BY	DATE	REVISION

P.O.	
REQ.	

Project: **SVS Boiler Replacement**

TAG NO:	**FIT-4368**	Hookup Drawings:	J514	Loop Wiring Diagram:						<-
		Spec:	40 9500	Line / Vessel Number:	N/A					<-
Asset No:		P&ID:	J706	Line ID:	6.07	Size:	6	Schedule:	40	<-
Service Description:	Boiler FW Pump 3 Flow Indicating Transmitter			Manufacturer:	Sierra Instruments					<-
				Model:	240/241					<-
Safety Class	GS			Quality Assurance Level						<-

PROCESS CONDITIONS

Fluid:	Water		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:	<-
Fluid State Present:	Liquid			Min:	0	PPH	N/A	N/A	N/A	N/A	<-
Compressibility (Z):	N/A	Units:		Normal (Operating):	126,000		N/A		N/A		<-
Temperature @ Operating:	75	deg F		Max (Full Scale):	250000		N/A		N/A		<-
Pressure @ Operating:	40	psig		SG/Density @ Operating:		lbm / in^3	N/A	N/A			<-
Vapor Pressure:	No			Viscosity @ Operating:	N/A			N/A			<-
Base Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):	N/A		% Solids:	N/A			<-
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	SS			<-
Flange Material:	SS			Flange Rating	ANSI Class 600#						<-

FLOW TUBE

Process Conenction					
Tube Material	316SS	Liner Material			
Element Type	Shedder Bar	Electrode Material			
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Grounding Type:		Grounding Material:			
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protoco:	HART	Location:	Remote		
Max Flow(gpm)		Normal:	N/A	Minimum	
Max Temp (deg F)		Minimum			
Max Press (psi)	Flange Rating	Minimum			
Max velocity (ft/s)	33	Min Cond (uS/cm)	N/A		
Vacuum Possibility	No				

CONVERTER

Voltage:					
Power Wiring:		Signal Type:	4 - 20 mA		
Communication Protoco:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Pulse Frequency (pps)	N/A				
Operating temp (deg F)					
Calibrated Span (gpm):					
Factory Calibration:	Yes				
Body Material:					
SS Tag:	FIT-4368				
Accuracy:	0.75% reading				
Alarms	qty 1 dry contact	Rating	30VDC or 120mA		
Status	qty 2 dry contact	Rating	30VDC or 120mA		
Mounting	Flush Panel				

NOTES

With Totalizer

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Vortex
Flow Instrument

DATA SHEET NO.	REV.
FQIT-3005	0

SHEET	OF	DATE
1	1	12-12-2012

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NCC	AME		

NO.	BY	DATE	REVISION

P.O.	
REQ.	

Project: **SVS Boiler Replacement**

TAG NO:	**FQIT-3005**	Hookup Drawings:	J514	Loop Wiring Diagram:					rev <-
		Spec:	40 9500	Line / Vessel Number:	N/A				rev <-
Asset No:		P&ID:	J714	Line ID:	7.98	Size:	8	Schedule:	40 <-
Service Description:	Natural Gas Supply Flow Indicating Transmitter w/ Totalizer			Manufacturer:	Sierra Instruments				<-
				Model:	240/241				<-
Safety Class	GS			Quality Assurance Level					<-

PROCESS CONDITIONS

Fluid:	Nat Gas		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:	<-
Fluid State Present:	Vapor			Min:	N/A	N/A	0	PPH	N/A	N/A	<-
Compressibility (Z):	Water based	Units:		Normal (Operating):	N/A				N/A		<-
Temperature @ Operating:		deg F		Max (Full Scale):	N/A		10000		N/A		<-
Pressure @ Operating:		psig		SG/Density @ Operating:		lbm / in^3	N/A	N/A			<-
Vapor Pressure:				Viscosity @ Operating:	N/A			N/A			<-
Base Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):	N/A		% Solids:	N/A			<-
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	SS			<-
Flange Material:	SS			Flange Rating	ANSI 300#						<-

FLOW TUBE

Process Conenction					
Tube Material	316SS	Liner Material			
Element Type	Shedder Bar	Electrode Material			
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Grounding Type:		Grounding Material:			
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow(gpm)		Normal:	N/A	Minimum	
Max Temp (deg F)		Minimum			
Max Press (psi)	Flange Rating	Minimum			
Max velocity (ft/s)	33	Min Cond (uS/cm)	N/A		
Vacuum Possibility	No				

CONVERTER

Voltage:					
Power Wiring:		Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Pulse Frequency (pps)	N/A				
Operating temp (deg F)					
Calibrated Span (gpm):					
Factory Calibration:	Yes				
Body Material:					
SS Tag:	FQIT-3005				
Accuracy:	0.75% reading				
Alarms	qty 1 dry contact	Rating	30VDC or 120mA		
Status	qty 2 dry contact	Rating	30VDC or 120mA		
Mounting	Flush Panel				

NOTES

With Totalizer

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

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Flow Instrument

DATA SHEET NO.	REV.
FQIT-3100	0

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1	1	12-12-2012

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NO.	BY	DATE	REVISION

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Project: SVS Boiler Replacement

TAG NO:	FQIT-3100	Hookup Drawings:	J514	Loop Wiring Diagram:					rev <-
		Spec:	40 9500	Line / Vessel Number:	N/A				<-
Asset No:		P&ID:	J709	Line ID:	6.07	Size:	6	Schedule: 40	<-
Service Description:	Natural Gas Supply to Boiler 1 Flow Indicating Transmitter w/Totalizer			Manufacturer:	Sierra Instruments				<-
				Model:	240/241				<-
Safety Class	GS			Quality Assurance Level					<-

PROCESS CONDITIONS

Fluid:	Nat Gas		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:	<-
Fluid State Present:	Vapor			Min:	N/A	N/A	0	PPH	N/A	N/A	<-
Compressibility (Z):	Water based	Units:		Normal (Operating):	N/A				N/A		<-
Temperature @ Operating:		deg F		Max (Full Scale):	N/A		10000		N/A		<-
Pressure @ Operating:		psig		SG/Density @ Operating:		lbm / in^3	N/A	N/A			<-
Vapor Pressure:				Viscosity @ Operating:	N/A			N/A			<-
Base Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):	N/A		% Solids:	N/A			<-
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	SS			<-
Flange Material:	SS			Flange Rating	ANSI 300#						<-

FLOW TUBE

Process Conenction					
Tube Material	316SS	Liner Material			
Element Type	Shedder Bar	Electrode Material			
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Grounding Type:		Grounding Material:			
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow(gpm)		Normal:	N/A	Minimum	
Max Temp (deg F)		Minimum			
Max Press (psi)	Flange Rating	Minimum			
Max velocity (ft/s)	33	Min Cond (uS/cm)	N/A		
Vacuum Possibility	No				

CONVERTER

Voltage:					
Power Wiring:		Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Pulse Frequency (pps)	N/A				
Operating temp (deg F)					
Calibrated Span (gpm):					
Factory Calibration:	Yes				
Body Material:					
SS Tag:	FQIT-3100				
Accuracy:	0.75% reading				
Alarms	qty 1 dry contact	Rating	30VDC or 120mA		
Status	qty 2 dry contact	Rating	30VDC or 120mA		
Mounting	Flush Panel				

NOTES

With Totalizer

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Vortex
Flow Instrument

DATA SHEET NO.			REV.
FQIT-3200			0
SHEET	OF	DATE	
1	1	12-12-2012	
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NO.	BY	DATE	REVISION

Project: SVS Boiler Replacement

TAG NO: FQIT-3200

Hookup Drawings:	J514	Loop Wiring Diagram:	
Spec:	40 9500	Line / Vessel Number:	N/A
Asset No:		P&ID:	J711
Service Description:	Natural Gas Supply to Boiler 2 Flow Indicating Transmitter w/Totalizer	Manufacturer:	Sierra Instruments
		Model:	240/241
Safety Class	GS	Quality Assurance Level	

Line ID:	6.07	Size:	6	Schedule:	40

PROCESS CONDITIONS

Fluid:	Nat Gas		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:
Fluid State Present:	Vapor			Min:	N/A	N/A	0	PPH	N/A	N/A
Compressibility (Z):	Water based	Units:		Normal (Operating):	N/A				N/A	
Temperature @ Operating:		deg F		Max (Full Scale):	N/A		10000		N/A	
Pressure @ Operating:		psig		SG/Density @ Operating:		lbm / in^3	N/A	N/A		
Vapor Pressure:				Viscosity @ Operating:	N/A			N/A		
Base Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):	N/A		% Solids:	N/A		
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	SS		
Flange Material:	SS			Flange Rating	ANSI 300#					

FLOW TUBE

Process Conenction					
Tube Material	316SS	Liner Material			
Element Type	Shedder Bar	Electrode Material			
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Grounding Type:		Grounding Material:			
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow(gpm)		Normal:	N/A	Minimum	
Max Temp (deg F)		Minimum			
Max Press (psi)	Flange Rating	Minimum			
Max velocity (ft/s)	33	Min Cond (uS/cm)	N/A		
Vacuum Possibility	No				

CONVERTER

Voltage:					
Power Wiring:		Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Pulse Frequency (pps)	N/A				
Operating temp (deg F)					
Calibrated Span (gpm):					
Factory Calibration:	Yes				
Body Material:					
SS Tag:	FQIT-3200				
Accuracy:	0.75% reading				
Alarms	qty 1 dry contact	Rating	30VDC or 120mA		
Status	qty 2 dry contact	Rating	30VDC or 120mA		
Mounting	Flush Panel				

NOTES

With Totalizer

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
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Vortex
Flow Instrument

DATA SHEET NO.	REV.
FQIT-3300	0

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1	1	12-12-2012

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Project: **SVS Boiler Replacement**

TAG NO:	**FQIT-3300**	Hookup Drawings:	J514	Loop Wiring Diagram:					rev <-
		Spec:	40 9500	Line / Vessel Number:	N/A				rev <-
Asset No:		P&ID:	J713	Line ID:	6.07	Size:	6	Schedule:	40 <-
Service Description:	Natural Gas Supply to Boiler 3 Flow Indicating Transmitter w/Totalizer			Manufacturer:	Sierra Instruments				<-
				Model:	240/241				<-
Safety Class	GS			Quality Assurance Level					<-

PROCESS CONDITIONS

Fluid:	Nat Gas		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:	<-
Fluid State Present:	Vapor			Min:	N/A	N/A	0	PPH	N/A	N/A	<-
Compressibility (Z):	Water based	Units:		Normal (Operating):	N/A				N/A		<-
Temperature @ Operating:		deg F		Max (Full Scale):	N/A		10000		N/A		<-
Pressure @ Operating:		psig		SG/Density @ Operating:		lbm / in^3	N/A	N/A			<-
Vapor Pressure:				Viscosity @ Operating:	N/A			N/A			<-
Base Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):	N/A		% Solids:	N/A			<-
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	SS			<-
Flange Material:	SS			Flange Rating	ANSI 300#						<-

FLOW TUBE

Process Conenction					
Tube Material	316SS	Liner Material			
Element Type	Shedder Bar	Electrode Material			
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Grounding Type:		Grounding Material:			
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow(gpm)		Normal:	N/A	Minimum	
Max Temp (deg F)		Minimum			
Max Press (psi)	Flange Rating	Minimum			
Max velocity (ft/s)	33	Min Cond (uS/cm)	N/A		
Vacuum Possibility	No				

CONVERTER

Voltage:					
Power Wiring:		Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Pulse Frequency (pps)	N/A				
Operating temp (deg F)					
Calibrated Span (gpm):					
Factory Calibration:	Yes				
Body Material:					
SS Tag:	FQIT-3300				
Accuracy:	0.75% reading				
Alarms	qty 1 dry contact	Rating	30VDC or 120mA		
Status	qty 2 dry contact	Rating	30VDC or 120mA		
Mounting	Flush Panel				

NOTES

With Totalizer

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
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Flow Instrument

DATA SHEET NO.			REV.
FQIT-4082			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
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P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project: **SVS Boiler Replacement**

TAG NO:	**FQIT-4082**	Hookup Drawings:	J514	Loop Wiring Diagram:						<-
		Spec:	40 9500	Line / Vessel Number:	N/A					<-
Asset No:		P&ID:	J701	Line ID:	6.07	Size:	6	Schedule:	40	<-
Service Description:	Water Softener Outlet Flow Indicating Transmitter w/ Totalizer			Manufacturer:	Sierra Instruments					<-
				Model:	240/241					<-
Safety Class	GS			Quality Assurance Level						<-

PROCESS CONDITIONS

Fluid:	Water		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:	<-
Fluid State Present:	Liquid			Min:	0	PPH	N/A	N/A	N/A	N/A	<-
Compressibility (Z):	N/A	Units:		Normal (Operating):	213,000		N/A		N/A		<-
Temperature @ Operating:	75	deg F		Max (Full Scale):	500000		N/A		N/A		<-
Pressure @ Operating:	40	psig		SG/Density @ Operating:		lbm / in^3	N/A	N/A			<-
Vapor Pressure:	No			Viscosity @ Operating:	N/A			N/A			<-
Base Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):	N/A		% Solids:	N/A			<-
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	SS			<-
Flange Material:	SS			Flange Rating	Class 150						<-

FLOW TUBE

Process Conenction	CL150 Flange					
Tube Material	316SS	Liner Material				
Element Type	Rotary	Electrode Material				
Meter Casing	N/A					
Electrical Protection:	N/A	Temperature Category:	N/A			
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7	
Grounding Type:		Grounding Material:				
Voltage:	N/A					
Power Wiring:	See notes	Signal Type:	4 - 20 mA			
Communication Protocol:	HART	Location:	Remote			
Max Flow(gpm)		Normal:	N/A	Minimum		
Max Temp (deg F)		Minimum				
Max Press (psi)	Flange Rating	Minimum				
Max velocity (ft/s)		Min Cond (uS/cm)	N/A			
Vacuum Possibility	No					

CONVERTER

Voltage:						
Power Wiring:		Signal Type:	4 - 20 mA			
Communication Protocol:	HART	Location:	Remote			
Electrical Protection:	N/A	Temperature Category:	N/A			
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7	
Pulse Frequency (pps)	N/A					
Operating temp (deg F)						
Calibrated Span (gpm):						
Factory Calibration:	Yes					
Body Material:						
SS Tag:	FQIT-4082					
Accuracy:	0.75% reading					
Alarms	qty 1 dry contact	Rating	30VDC or 120mA			
Status	qty 2 dry contact	Rating	30VDC or 120mA			
Mounting	Flush Panel					

NOTES

With Totalizer

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
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Vortex
Flow Instrument

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FQIT-5111			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: **SVS Boiler Replacement**

TAG NO:	**FQIT-5111**	Hookup Drawings:	J514	Loop Wiring Diagram:					rev <-
		Spec:	40 9500	Line / Vessel Number:	N/A				rev <-
Asset No:		P&ID:	J709	Line ID:	6.07	Size:	6	Schedule:	40 <-
Service Description:	Boiler 1 Steam Flow Indicating Transmitter w/ Totalizer			Manufacturer:	Sierra Instruments				<-
				Model:	240/241				<-
Safety Class	GS			Quality Assurance Level					<-

PROCESS CONDITIONS

Fluid:	Steam		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:	<-
Fluid State Present:	Steam			Min:	N/A	N/A	0	KPPH	N/A	N/A	<-
Compressibility (Z):	Water based	Units:		Normal (Operating):	N/A				N/A		<-
Temperature @ Operating:		deg F		Max (Full Scale):	N/A		150		N/A		<-
Pressure @ Operating:		psig		SG/Density @ Operating:		lbm / in^3	N/A	N/A			<-
Vapor Pressure:				Viscosity @ Operating:	N/A			N/A			<-
Base Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):	N/A		% Solids:	N/A			<-
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	SS			<-
Flange Material:	SS			Flange Rating	ANSI 300#						<-

FLOW TUBE

Process Conenction					
Tube Material	316SS	Liner Material			
Element Type	Shedder Bar	Electrode Material			
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Grounding Type:		Grounding Material:			
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow(gpm)		Normal:	N/A	Minimum	
Max Temp (deg F)		Minimum			
Max Press (psi)	Flange Rating	Minimum			
Max velocity (ft/s)	33	Min Cond (uS/cm)	N/A		
Vacuum Possibility	No				

CONVERTER

Voltage:					
Power Wiring:		Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Pulse Frequency (pps)	N/A				
Operating temp (deg F)					
Calibrated Span (gpm):					
Factory Calibration:	Yes				
Body Material:					
SS Tag:	FQIT-5111				
Accuracy:	0.75% reading				
Alarms	qty 1 dry contact	Rating	30VDC or 120mA		
Status	qty 2 dry contact	Rating	30VDC or 120mA		
Mounting	Flush Panel				

NOTES

With Totalizer

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
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Vortex
Flow Instrument

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FQIT-5311			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: **SVS Boiler Replacement**

TAG NO:	**FQIT-5311**	Hookup Drawings:	J514	Loop Wiring Diagram:						rev <-
		Spec:	40 9500	Line / Vessel Number:	N/A					rev <-
Asset No:		P&ID:	J711	Line ID:	6.07	Size:	6	Schedule:	40	<-
Service Description:	Boiler 2 Steam Flow Indicating Transmitter w/ Totalizer			Manufacturer:	Sierra Instruments					<-
				Model:	240/241					<-
Safety Class	GS			Quality Assurance Level						<-

PROCESS CONDITIONS

Fluid:	Steam		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:	<-
Fluid State Present:	Steam			Min:	N/A	N/A	0	KPPH	N/A	N/A	<-
Compressibility (Z):	Water based	Units:		Normal (Operating):	N/A				N/A		<-
Temperature @ Operating:		deg F		Max (Full Scale):	N/A		150		N/A		<-
Pressure @ Operating:		psig		SG/Density @ Operating:		lbm / in^3	N/A	N/A			<-
Vapor Pressure:				Viscosity @ Operating:	N/A			N/A			<-
Base Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):	N/A		% Solids:	N/A			<-
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	SS			<-
Flange Material:	SS			Flange Rating	ANSI 300#						<-

FLOW TUBE

Process Conenction					
Tube Material	316SS	Liner Material			
Element Type	Shedder Bar	Electrode Material			
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Grounding Type:		Grounding Material:			
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow(gpm)		Normal:	N/A	Minimum	
Max Temp (deg F)		Minimum			
Max Press (psi)	Flange Rating	Minimum			
Max velocity (ft/s)	33	Min Cond (uS/cm)	N/A		
Vacuum Possibility	No				

CONVERTER

Voltage:					
Power Wiring:		Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Pulse Frequency (pps)	N/A				
Operating temp (deg F)					
Calibrated Span (gpm):					
Factory Calibration:	Yes				
Body Material:					
SS Tag:	FQIT-5311				
Accuracy:	0.75% reading				
Alarms	qty 1 dry contact	Rating	30VDC or 120mA		
Status	qty 2 dry contact	Rating	30VDC or 120mA		
Mounting	Flush Panel				

NOTES

With Totalizer

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Vortex
Flow Instrument

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FQIT-5511			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: **SVS Boiler Replacement**

TAG NO:	**FQIT-5511**	Hookup Drawings:	J514	Loop Wiring Diagram:						rev <-
		Spec:	40 9500	Line / Vessel Number:	N/A					rev <-
Asset No:		P&ID:	J713	Line ID:	6.07	Size:	6	Schedule:	40	<-
Service Description:	Boiler 3 Steam Flow Indicating Transmitter w/ Totalizer			Manufacturer:	Sierra Instruments					<-
				Model:	240/241					<-
Safety Class	GS			Quality Assurance Level						<-

PROCESS CONDITIONS

Fluid:	Steam		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:	<-
Fluid State Present:	Steam			Min:	N/A	N/A	0	KPPH	N/A	N/A	<-
Compressibility (Z):	Water based	Units:		Normal (Operating):	N/A				N/A		<-
Temperature @ Operating:		deg F		Max (Full Scale):	N/A		150		N/A		<-
Pressure @ Operating:		psig		SG/Density @ Operating:		lbm / in^3	N/A	N/A			<-
Vapor Pressure:				Viscosity @ Operating:	N/A			N/A			<-
Base Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):	N/A		% Solids:	N/A			<-
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	SS			<-
Flange Material:	SS			Flange Rating	ANSI 300#						<-

FLOW TUBE

Process Conenction					
Tube Material	316SS	Liner Material			
Element Type	Shedder Bar	Electrode Material			
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Grounding Type:		Grounding Material:			
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow(gpm)		Normal:	N/A	Minimum	
Max Temp (deg F)		Minimum			
Max Press (psi)	Flange Rating	Minimum			
Max velocity (ft/s)	33	Min Cond (uS/cm)	N/A		
Vacuum Possibility	No				

CONVERTER

Voltage:					
Power Wiring:		Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Pulse Frequency (pps)	N/A				
Operating temp (deg F)					
Calibrated Span (gpm):					
Factory Calibration:	Yes				
Body Material:					
SS Tag:	FQIT-5511				
Accuracy:	0.75% reading				
Alarms	qty 1 dry contact	Rating	30VDC or 120mA		
Status	qty 2 dry contact	Rating	30VDC or 120mA		
Mounting	Flush Panel				

NOTES

With Totalizer

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Vortex
Flow Instrument

DATA SHEET NO.	REV.
FQIT-5823	0

SHEET	OF	DATE
1	1	12-12-2012

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NCC	AME		

NO.	BY	DATE	REVISION

P.O.	
REQ.	

Project: SVS Boiler Replacement

TAG NO:	FQIT-5823	Hookup Drawings:	J514	Loop Wiring Diagram:						rev <-
		Spec:	40 9500	Line / Vessel Number:	N/A					rev <-
Asset No:		P&ID:	J707	Line ID:	4.03	Size:	4	Schedule:	40	<-
Service Description:	Steam Recirculation Flow Transmitter w/Totalizer			Manufacturer:	Sierra Instruments					<-
				Model:	240/241					<-
Safety Class	GS			Quality Assurance Level						<-

PROCESS CONDITIONS

Fluid:	Steam		Flow:		Liquid:	Units:	Vapor:	Units:	Differential:	Units:	<-
Fluid State Present:	Steam			Min:	N/A	N/A	0	PPH	N/A	N/A	<-
Compressibility (Z):	Water based	Units:		Normal (Operating):	N/A				N/A		<-
Temperature @ Operating:		deg F		Max (Full Scale):	N/A		70000		N/A		<-
Pressure @ Operating:		psig		SG/Density @ Operating:		lbm / in^3	N/A	N/A			<-
Vapor Pressure:				Viscosity @ Operating:	N/A			N/A			<-
Base Pressure:	N/A			Specific Heat Ratio ($^{Cp}/_{Cv}$):	N/A		% Solids:	N/A			<-
Base Temperature:	N/A			Steam % Quality or °Superheat:	N/A		Pipe Material:	SS			<-
Flange Material:	SS			Flange Rating	ANSI 300#						<-

FLOW TUBE

Process Conenction					
Tube Material	316SS	Liner Material			
Element Type	Shedder Bar	Electrode Material			
Meter Casing	N/A				
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Grounding Type:		Grounding Material:			
Voltage:	N/A				
Power Wiring:	See notes	Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Max Flow(gpm)		Normal:	N/A	Minimum	
Max Temp (deg F)		Minimum			
Max Press (psi)	Flange Rating	Minimum			
Max velocity (ft/s)	33	Min Cond (uS/cm)	N/A		
Vacuum Possibility	No				

CONVERTER

Voltage:					
Power Wiring:		Signal Type:	4 - 20 mA		
Communication Protocol:	HART	Location:	Remote		
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Pulse Frequency (pps)	N/A				
Operating temp (deg F)					
Calibrated Span (gpm):					
Factory Calibration:	Yes				
Body Material:					
SS Tag:	FQIT-5823				
Accuracy:	0.75% reading				
Alarms	qty 1 dry contact	Rating	30VDC or 120mA		
Status	qty 2 dry contact	Rating	30VDC or 120mA		
Mounting	Flush Panel				

NOTES

With Totalizer

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Flow Detector
Vane Flow Switch

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FS-4123			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**FS-4123**	Hookup Drawing No:	J515	Loop Wiring Diagram:		rev <-
		Spec:	40 9500	Line Size	6	<-
Asset No:		P&ID:	J701			<-
Service Description:	Feedwater Tank Level Control Flow Switch			Manufacturer:	Dwyer	<-
				Model:	Series FS-2	<-
Safety Class:	GS				N/A	<-
Quality Assurance Level:					N/A	<-

PROCESS CONDITIONS

Lower Fluid									
Fluid:	Water								
Fluid Density @ Operating Temperature:	N/A								
Viscosity @ Operating Temperature:	N/A								
% Solids:	N/A	Dielectric Constant:	Water Based						
Service:	SCW	Critical:	N/A						
Temperature Min:	35	Normal:	60	Max:	100	deg F			
Pressure Min:	atm	Normal:	50	Max:	100	psig			
Area Classification:	N/A	Ambient Temperature Requirements:	100 deg F						

Flow: Setpoints	Liquid:	Units:	Vapor:	Units:
FSLL	N/A	GPM	N/A	N/A
FSL	N/A		N/A	
FSH	70		N/A	
FSHH	N/A		N/A	
DB	N/A		N/A	

BODY / CAGE

Cage Type:	N/A		
Upper Connection Size:	N/A	Type:	N/A
Lower Connection Size:	N/A	Type:	N/A
Body / Cage Material:	N/A	Rating:	N/A
Rotatable Head:	N/A	Orientation:	N/A
Drain Valve:	N/A	Vent Valve:	N/A
Cage Length:	N/A	Diameter:	N/A
Nozzle Extension Length:	N/A		
Span Between Nozzles:	N/A		
Cooling Extension:	N/A		
Cage Mounting:			
N/A			

TRANSMITTER

Voltage:	N/A				
Power Wiring:		Signal Type:	N/A		
Communication Protocal:	N/A	Location:			
Smart:	N/A	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	None	Temperature Category:			
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	N/A				
Accuracy:	N/A				
Sensor Connection:	N/A				
Conduit Connection:	N/A				
Body Material:	N/A				
Calibrated Range:	N/A	Full Range:	N/A		
Gasket Material:	N/A	SS Tag:	N/A		

ELEMENT

Type:		Signal Gauge:	N/A
Gauge Material:	N/A	Gauge Dimensions:	N/A
Insertion Depth:	N/A		
Process Connection:	Immersion		
Radar Frequency:	N/A		
Displacer Extension:	N/A		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	FS-4123			
	Power Rating:	~110 V AC 50/60 Hz	Type:	N/C	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A		
Conduit Connection:					
Manufacturer:					
Model No.	See Notes				
Electrical Protection:	N/A	Temperature Category:	T6		
Gas Group:	N/A	Enclosure Protection:	SEE NOTES		N/A

NOTES

NEMA 4X
Switch must be installed vertically on horizontal pipe runs.

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

Element Tag	FS-4123
Remote Indicator Tag	N/A

National Aeronautics and Space Administration
Ames Research Center

Flow Detector
Vane Flow Switch

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FSL-4012			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**FSL-4012**	Hookup Drawing No:	J515	Loop Wiring Diagram:		rev <-
		Spec:	40 9500	Line Size	0.5	<-
Asset No:		P&ID:	J706			<-
Service Description:	Boiler FW Pump 1 Cooling Water Flow Switch Low			Manufacturer:	McDonnel & Miller	<-
				Model:	Series FS-6	<-
Safety Class:	GS			N/A		<-
Quality Assurance Level:				N/A		<-

PROCESS CONDITIONS

Lower Fluid									
Fluid:	Water			Flow: Setpoints		Liquid:	Units:	Vapor:	Units:
Fluid Density @ Operating Temperature:	N/A				FSLL	N/A	gpm	N/A	N/A
Viscosity @ Operating Temperature:	N/A				FSL	By Vendor		N/A	
% Solids:	N/A	Dielectric Constant:	Water Based		FSH	-		N/A	
Service:	IW	Critical:	N/A		FSHH	N/A		N/A	
					DB	N/A		N/A	

Temperature Min:	35	Normal:	60	Max:	100	deg F
Pressure Min:	atm	Normal:	50	Max:	100	psig
Area Classification:	N/A	Ambient Temperature Requirements:	100 deg F			

BODY / CAGE

Cage Type:	N/A		
Upper Connection Size:	N/A	Type:	N/A
Lower Connection Size:	N/A	Type:	N/A
Body / Cage Material:	N/A	Rating:	N/A
Rotatable Head:	N/A	Orientation:	N/A
Drain Valve:	N/A	Vent Valve:	N/A
Cage Length:	N/A	Diameter:	N/A
Nozzle Extension Length:	N/A		
Span Between Nozzles:	N/A		
Cooling Extension:	N/A		
Cage Mounting:			
N/A			

TRANSMITTER

Voltage:	N/A				
Power Wiring:		Signal Type:	N/A		
Communication Protocal:	N/A	Location:			
Smart:	N/A	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	None	Temperature Category:			
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	N/A				
Accuracy:	N/A				
Sensor Connection:	N/A				
Conduit Connection:	N/A				
Body Material:	N/A				
Calibrated Range:	N/A	Full Range:	N/A		
Gasket Material:	N/A	SS Tag:	N/A		

ELEMENT

Type:		Signal Gauge:	N/A
Gauge Material:	N/A	Gauge Dimensions:	N/A
Insertion Depth:	N/A		
Process Connection:	Immersion		
Radar Frequency:	N/A		
Displacer Extension:	N/A		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	FSL-4012			
	Power Rating:	~110 V AC 50/60 Hz	Type:	N/C	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A		
Conduit Connection:					
Manufacturer:					
Model No.	See Notes				
Electrical Protection:	N/A	Temperature Category:	T6		
Gas Group:	N/A	Enclosure Protection:	SEE NOTES		N/A

NOTES

NEMA 4X
Switch must be installed vertically on horizontal pipe runs.

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument. Pump manufacturer will specify cooling flow requirement.

Element Tag	FSL-4012
Remote Indicator Tag	N/A

National Aeronautics and Space Administration
Ames Research Center

Flow Detector
Vane Flow Switch

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FSL-4017			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**FSL-4017**	Hookup Drawing No:	J515	Loop Wiring Diagram:		rev <-
		Spec:	40 9500	Line Size	0.5	<-
Asset No:		P&ID:	J706			<-
Service Description:	Boiler FW Pump 2 Cooling Water Flow Switch Low			Manufacturer:	McDonnel & Miller	<-
				Model:	Series FS-6	<-
Safety Class:	GS				N/A	<-
Quality Assurance Level:					N/A	<-

PROCESS CONDITIONS

Lower Fluid									
Fluid:	Water								
Fluid Density @ Operating Temperature:	N/A								
Viscosity @ Operating Temperature:	N/A								
% Solids:	N/A	Dielectric Constant:	Water Based						
Service:	IW	Critical:	N/A						
Temperature Min:	35	Normal:	60	Max:	100	deg F			
Pressure Min:	atm	Normal:	50	Max:	100	psig			
Area Classification:	N/A	Ambient Temperature Requirements:	100 deg F						

Flow: Setpoints	Liquid:	Units:	Vapor:	Units:
FSLL	N/A	gpm	N/A	N/A
FSL	By Vendor		N/A	
FSH	-		N/A	
FSHH	N/A		N/A	
DB	N/A		N/A	

BODY / CAGE

Cage Type:	N/A		
Upper Connection Size:	N/A	Type:	N/A
Lower Connection Size:	N/A	Type:	N/A
Body / Cage Material:	N/A	Rating:	N/A
Rotatable Head:	N/A	Orientation:	N/A
Drain Valve:	N/A	Vent Valve:	N/A
Cage Length:	N/A	Diameter:	N/A
Nozzle Extension Length:	N/A		
Span Between Nozzles:	N/A		
Cooling Extension:	N/A		
Cage Mounting:			
N/A			

TRANSMITTER

Voltage:	N/A				
Power Wiring:		Signal Type:	N/A		
Communication Protocal:	N/A	Location:			
Smart:	N/A	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	None	Temperature Category:			
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	N/A				
Accuracy:	N/A				
Sensor Connection:	N/A				
Conduit Connection:	N/A				
Body Material:	N/A				
Calibrated Range:	N/A	Full Range:	N/A		
Gasket Material:	N/A	SS Tag:	N/A		

ELEMENT

Type:		Signal Gauge:	N/A
Gauge Material:	N/A	Gauge Dimensions:	N/A
Insertion Depth:	N/A		
Process Connection:	Immersion		
Radar Frequency:	N/A		
Displacer Extension:	N/A		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	FSL-4017			
	Power Rating:	~110 V AC 50/60 Hz	Type:	N/C	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A		
Conduit Connection:					
Manufacturer:					
Model No.	See Notes				
Electrical Protection:	N/A	Temperature Category:	T6		
Gas Group:	N/A	Enclosure Protection:	SEE NOTES		N/A

NOTES

NEMA 4X
Switch must be installed vertically on horizontal pipe runs.

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument. Pump manufacturer will specify cooling flow requirement.

Element Tag	FSL-4017
Remote Indicator Tag	N/A

National Aeronautics and Space Administration
Ames Research Center

Flow Detector
Vane Flow Switch

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FSL-4022			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**FSL-4022**	Hookup Drawing No:	J515	Loop Wiring Diagram:		rev <-
		Spec:	40 9500	Line Size	0.5	<-
Asset No:		P&ID:	J706			<-
Service Description:	Boiler FW Pump 3 Cooling Water Flow Switch Low			Manufacturer:	McDonnel & Miller	<-
				Model:	Series FS-6	<-
Safety Class:	GS			N/A		<-
Quality Assurance Level:				N/A		<-

PROCESS CONDITIONS

Lower Fluid								
Fluid:	Water							
Fluid Density @ Operating Temperature:	N/A							
Viscosity @ Operating Temperature:	N/A							
% Solids:	N/A	Dielectric Constant:	Water Based					
Service:	IW	Critical:	N/A					
Temperature Min:	35	Normal:	60	Max:	100	deg F		
Pressure Min:	atm	Normal:	50	Max:	100	psig		
Area Classification:	N/A	Ambient Temperature Requirements:	100 deg F					

Flow: Setpoints	Liquid:	Units:	Vapor:	Units:
FSLL	N/A	gpm	N/A	N/A
FSL	By Vendor		N/A	
FSH	-		N/A	
FSHH	N/A		N/A	
DB	N/A		N/A	

BODY / CAGE

Cage Type:	N/A		
Upper Connection Size:	N/A	Type:	N/A
Lower Connection Size:	N/A	Type:	N/A
Body / Cage Material:	N/A	Rating:	N/A
Rotatable Head:	N/A	Orientation:	N/A
Drain Valve:	N/A	Vent Valve:	N/A
Cage Length:	N/A	Diameter:	N/A
Nozzle Extension Length:	N/A		
Span Between Nozzles:	N/A		
Cooling Extension:	N/A		
Cage Mounting:			
N/A			

TRANSMITTER

Voltage:	N/A				
Power Wiring:		Signal Type:	N/A		
Communication Protocal:	N/A	Location:			
Smart:	N/A	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	None	Temperature Category:			
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	N/A				
Accuracy:	N/A				
Sensor Connection:	N/A				
Conduit Connection:	N/A				
Body Material:	N/A				
Calibrated Range:	N/A	Full Range:	N/A		
Gasket Material:	N/A	SS Tag:	N/A		

ELEMENT

Type:		Signal Gauge:	N/A
Gauge Material:	N/A	Gauge Dimensions:	N/A
Insertion Depth:	N/A		
Process Connection:	Immersion		
Radar Frequency:	N/A		
Displacer Extension:	N/A		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	FSL-4022			
	Power Rating:	~110 V AC 50/60 Hz	Type:	N/C	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A		
Conduit Connection:					
Manufacturer:					
Model No.	See Notes				
Electrical Protection:	N/A	Temperature Category:	T6		
Gas Group:	N/A	Enclosure Protection:	SEE NOTES		N/A

NOTES

NEMA 4X
Switch must be installed vertically on horizontal pipe runs.

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument. Pump manufacturer will specify cooling flow requirement.

Element Tag	FSL-4022		
Remote Indicator Tag	N/A		

National Aeronautics and Space Administration
Ames Research Center

Flow Detector
Vane Flow Switch

DATA SHEET NO.	REV.
FSL-4101	0

SHEET	OF	DATE
1	1	12-12-2012

BY	CHK'D	PROC.	APPR.
NCC	AME		

NO.	BY	DATE	REVISION

P.O.
REQ.

Project: SVS Boiler Replacement

TAG NO: FSL-4101

Hookup Drawing No:	J515	Loop Wiring Diagram:	
Spec:	40 9500	Line Size	6
Asset No:		P&ID:	J701
Service Description:	Hot Well Heat Recovery Pump Flow Switch	Manufacturer:	McDonnel & Miller
		Model:	Series FS-6
Safety Class:	GS		N/A
Quality Assurance Level:			N/A

PROCESS CONDITIONS

Lower Fluid			
Fluid:	Water		
Fluid Density @ Operating Temperature:	N/A		
Viscosity @ Operating Temperature:	N/A		
% Solids:	N/A	Dielectric Constant:	Water Based
Service:	SCW	Critical:	N/A

Flow: Setpoints	Liquid:	Units:	Vapor:	Units:
FSLL	N/A	GPM	N/A	N/A
FSL	By Vendor		N/A	
FSH	-		N/A	
FSHH	N/A		N/A	
DB	N/A		N/A	

Temperature Min:	35	Normal:	60	Max:	100 deg F
Pressure Min:	atm	Normal:	50	Max:	100 psig
Area Classification:	N/A	Ambient Temperature Requirements:	100 deg F		

BODY / CAGE

Cage Type:	N/A		
Upper Connection Size:	N/A	Type:	N/A
Lower Connection Size:	N/A	Type:	N/A
Body / Cage Material:	N/A	Rating:	N/A
Rotatable Head:	N/A	Orientation:	N/A
Drain Valve:	N/A	Vent Valve:	N/A
Cage Length:	N/A	Diameter:	N/A
Nozzle Extension Length:	N/A		
Span Between Nozzles:	N/A		
Cooling Extension:	N/A		
Cage Mounting:			
N/A			

TRANSMITTER

Voltage:	N/A				
Power Wiring:		Signal Type:	N/A		
Communication Protocal:	N/A	Location:			
Smart:	N/A	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	None	Temperature Category:			
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	N/A				
Accuracy:	N/A				
Sensor Connection:	N/A				
Conduit Connection:	N/A				
Body Material:	N/A				
Calibrated Range:	N/A	Full Range:	N/A		
Gasket Material:	N/A	SS Tag:	N/A		

ELEMENT

Type:		Signal Gauge:	N/A
Gauge Material:	N/A	Gauge Dimensions:	N/A
Insertion Depth:	N/A		
Process Connection:	Immersion		
Radar Frequency:	N/A		
Displacer Extension:	N/A		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	FSL-4101			
	Power Rating:	~110 V AC 50/60 Hz	Type:	N/C	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	N/A	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A		
Conduit Connection:					
Manufacturer:					
Model No.	See Notes				
Electrical Protection:	N/A	Temperature Category:	T6		
Gas Group:	N/A	Enclosure Protection:	SEE NOTES		N/A

NOTES

NEMA 4X
Switch must be installed vertically on horizontal pipe runs.

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument. Pump manufacturer will specify cooling flow requirement.

Element Tag	FSL-4101		
Remote Indicator Tag	N/A		

National Aeronautics and Space Administration
Ames Research Center

Flow Detector
Vane Flow Switch

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FSL-4137			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: **SVS Boiler Replacement**

TAG NO:	**FSL-4137**	Hookup Drawing No:	J515	Loop Wiring Diagram:		<-
		Spec:	40 9500	Line Size	1.5	<-
Asset No:		P&ID:	J704			<-
Service Description:	Blowdown Pump HXP-2 Flow Switch			Manufacturer:	Dwyer	<-
				Model:	Series FS-2	<-
Safety Class:	GS			N/A		<-
Quality Assurance Level:				N/A		<-

PROCESS CONDITIONS

Lower Fluid			
Fluid:	Water		
Fluid Density @ Operating Temperature:	N/A		
Viscosity @ Operating Temperature:	N/A		
% Solids:	N/A	Dielectric Constant:	Water Based
Service:	SPW	Critical:	N/A

Flow: Setpoints	Liquid:	Units:	Vapor:	Units:	
FSLL	N/A	GPM	N/A	N/A	<-
FSL	-		N/A		<-
FSH	By Vendor		N/A		<-
FSHH	N/A		N/A		<-
DB	N/A		N/A		<-

Temperature Min:	35	Normal:	60	Max:	100	deg F <-
Pressure Min:	atm	Normal:	50	Max:	100	psig <-
Area Classification:	N/A	Ambient Temperature Requirements:		100 deg F		<-

BODY / CAGE

Cage Type:	N/A		
Upper Connection Size:	N/A	Type:	N/A
Lower Connection Size:	N/A	Type:	N/A
Body / Cage Material:	N/A	Rating:	N/A
Rotatable Head:	N/A	Orientation:	N/A
Drain Valve:	N/A	Vent Valve:	N/A
Cage Length:	N/A	Diameter:	N/A
Nozzle Extension Length:	N/A		
Span Between Nozzles:	N/A		
Cooling Extension:	N/A		
Cage Mounting:	N/A		

TRANSMITTER

Voltage:	N/A					<-
Power Wiring:		Signal Type:	N/A			<-
Communication Protocal	N/A	Location:				<-
Smart:	N/A	Indicate:	N/A	Isolate:	N/A	<-
Electrical Protection:	None	Temperature Category:				<-
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A	<-
Factory Calibration:	N/A					<-
Accuracy:	N/A					<-
Sensor Connection:	N/A					<-
Conduit Connection:	N/A					<-
Body Material:	N/A					<-
Calibrated Range:	N/A	Full Range:	N/A			<-
Gasket Material:	N/A	SS Tag:	N/A			<-

ELEMENT

Type:		Signal Gauge:	N/A
Gauge Material:	N/A	Gauge Dimensions	N/A
Insertion Depth:	N/A		
Process Connection:	Immersion		
Radar Frequency:	N/A		
Displacer Extension:	N/A		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	FSL-4137				<-
	Power Rating:	~110 V AC 50/60 Hz	Type:	N/C		<-
	Alarm Setting:	N/A				<-
RELAY 2	Tag No:	N/A				<-
	Power Rating:	N/A	Type:	N/A		<-
	Alarm Setting:	N/A				<-
Contact Rating:	N/A	Contact Form:	N/A			<-
Conduit Connection:						<-
Manufacturer:						<-
Model No.	See Notes					<-
Electrical Protection:	N/A	Temperature Category:	T6			<-
Gas Group:	N/A	Enclosure Protection:	SEE NOTES	N/A		<-

NOTES

NEMA 4X
Switch must be installed vertically on horizontal pipe runs.

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument. Pump manufacturer will specify cooling flow requirement.

Element Tag	FSL-4137		
Remote Indicator Tag	N/A		

National Aeronautics and Space Administration
Ames Research Center

Flow Detector

Vane Flow Switch

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
FSL-5711			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: **SVS Boiler Replacement**

TAG NO:	**FSL-5711**	Hookup Drawing No:	J515	Loop Wiring Diagram:		<-
		Spec:	40 9500	Line Size	1.5	<-
Asset No:		P&ID:	J704			<-
Service Description:	Intermittent Blowdown Level Control Flow Switch			Manufacturer:	Dwyer	<-
				Model:	Series FS-2	<-
Safety Class:	GS			N/A		<-
Quality Assurance Level:				N/A		<-

PROCESS CONDITIONS

Lower Fluid			
Fluid:	Water		
Fluid Density @ Operating Temperature:	N/A		
Viscosity @ Operating Temperature:	N/A		
% Solids:	N/A	Dielectric Constant:	Water Based
Service:	CBD	Critical:	N/A

Flow: Setpoints	Liquid:	Units:	Vapor:	Units:	
FSLL	N/A	GPM	N/A	N/A	<-
FSL	-		N/A		<-
FSH	By Vendor		N/A		<-
FSHH	N/A		N/A		<-
DB	N/A		N/A		<-

Temperature Min:	35	Normal:	60	Max:	100	deg F <-
Pressure Min:	atm	Normal:	50	Max:	100	psig <-
Area Classification:	N/A	Ambient Temperature Requirements:		100 deg F		<-

BODY / CAGE

Cage Type:	N/A		
Upper Connection Size:	N/A	Type:	N/A
Lower Connection Size:	N/A	Type:	N/A
Body / Cage Material:	N/A	Rating:	N/A
Rotatable Head:	N/A	Orientation:	N/A
Drain Valve:	N/A	Vent Valve:	N/A
Cage Length:	N/A	Diameter:	N/A
Nozzle Extension Length:	N/A		
Span Between Nozzles:	N/A		
Cooling Extension:	N/A		
Cage Mounting:	N/A		

TRANSMITTER

Voltage:	N/A					<-
Power Wiring:		Signal Type:	N/A			<-
Communication Protocal	N/A	Location:				<-
Smart:	N/A	Indicate:	N/A	Isolate:	N/A	<-
Electrical Protection:	None	Temperature Category:				<-
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A	<-
Factory Calibration:	N/A					<-
Accuracy:	N/A					<-
Sensor Connection:	N/A					<-
Conduit Connection:	N/A					<-
Body Material:	N/A					<-
Calibrated Range:	N/A	Full Range:	N/A			<-
Gasket Material:	N/A	SS Tag:	N/A			<-

ELEMENT

Type:		Signal Gauge:	N/A
Gauge Material:	N/A	Gauge Dimensions	N/A
Insertion Depth:	N/A		
Process Connection:	Immersion		
Radar Frequency:	N/A		
Displacer Extension:	N/A		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	FSL-5711			<-
	Power Rating:	~110 V AC 50/60 Hz	Type:	N/C	<-
	Alarm Setting:	N/A			<-
RELAY 2	Tag No:	N/A			<-
	Power Rating:	N/A	Type:	N/A	<-
	Alarm Setting:	N/A			<-
Contact Rating:	N/A	Contact Form:	N/A		<-
Conduit Connection:					<-
Manufacturer:					<-
Model No.	See Notes				<-
Electrical Protection:	N/A	Temperature Category:	T6		<-
Gas Group:	N/A	Enclosure Protection:	SEE NOTES	N/A	<-

NOTES

NEMA 4X
Switch must be installed vertically on horizontal pipe runs.

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument. Pump manufacturer will specify cooling flow requirement.

Element Tag	FSL-5711		
Remote Indicator Tag	N/A		

National Aeronautics and Space Administration
Ames Research Center

Level Instrument
Gage Glasses and Cocks

DATA SHEET NO.			REV.
LG-4234			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project: **SVS Boiler Replacement**

TAG NO:	**LG-4234**	Hookup Drawing No:	J513	Loop Wiring Diagram:	N/A	<-
		Spec:	40 9500	Vessel Number:	N/A	<-
Asset No:		P&ID:	J702			<-
Service Description:	Feedwater Tank Local Level Indicator			Manufacturer:	Penberthy	<-
				Model:	Tubular Glass Gage	<-
Safety Level	GS			Quality Assurance Level		<-

PROCESS CONDITIONS

Lower Fluid				Upper Fluid				Units	
Fluid:	Water			Fluid:	N/A			Inches	<-
Fluid Density @ Operating Temperature:	N/A			Fluid Density @ Operating Temperature:	N/A			lbm/in^3	<-
Viscosity @ Operating Temperature:	N/A			Viscosity @ Operating Temperature:	N/A				<-
% solids:	N/A	Dielectric Constant:	Water Based	% Solids:	N/A	Dielectric Constant:	Water		<-
Service:	BFW	Critical:	N/A	Service:	N/A	Critical:	N/A		<-

Temperature Min:	32	Normal:	N/A	Max:	275	deg F	<-
Pressure Min:	Atm	Normal:	Height + 7	Max:	Height + 30	psig	<-
Area Classification:	N/A	Ambient Temperature Requirements:	275				<-

GLASS

Type:	Tubular Glass	Glass type:	Reflex	
Glass Diameter	5/8 in	Glass height	20 in	
Glass Grade	High Pressure	Pressure rating	355 psig	
Process Connection:	1/2 in NPTF			
Protection:	Refractive			
Packing Material	Neoprene	Rating	300 deg F	
Hydraulic adapter	N/A			

COCKS

Type:	Offset	Integral Bonnet	Yes	<-
Gage connection	5/8 in suffing box			<-
Body Material	Bronze	Packng Material	Rubber	<-
Process Connection:	2 in CL150 flange			<-
Drain Connection:	1/8 in NPTF			<-
Ball Check Shutoff	Vertical lower/ horizontal upper valve			<-
Seat	Integral			<-
Max Pressure:	120 psi @ 200 deg F			<-
Model	N6A Straight Pattern			<-

NOTES

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Level Instrument

Gage Glasses and Cocks

DATA SHEET NO.			REV.
LG-4401			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project: **SVS Boiler Replacement**

TAG NO:	**LG-4401**	Hookup Drawing No:	J513	Loop Wiring Diagram:	N/A	<-
		Spec:	40 9500	Vessel Number:	N/A	<-
Asset No:		P&ID:	J703			<-
Service Description:	Sulfite Tank Level Gauge			Manufacturer:	Penberthy	<-
				Model:	Tubular Glass Gage	<-
Safety Level	GS			Quality Assurance Level		<-

PROCESS CONDITIONS

Lower Fluid				Upper Fluid				Units	
Fluid:	Sulfite			Fluid:	N/A			Inches	<-
Fluid Density @ Operating Temperature:	N/A			Fluid Density @ Operating Temperature:	N/A			lbm/in^3	<-
Viscosity @ Operating Temperature:	N/A			Viscosity @ Operating Temperature:	N/A				<-
% solids:	N/A	Dielectric Constant:	Water Based	% Solids:	N/A	Dielectric Constant:	Water		<-
Service:	Sulfite	Critical:	N/A	Service:	N/A	Critical:	N/A		<-

Temperature Min:	32	Normal:	N/A	Max:	100	deg F	<-
Pressure Min:	Atm	Normal:	Height	Max:	atm	psig	<-
Area Classification:	N/A	Ambient Temperature Requirements:	100				<-

GLASS

Type:	Tubular Glass	Glass type:	Reflex	
Glass Diameter	5/8 in	Glass height	20 in	
Glass Grade	High Pressure	Pressure rating	355 psig	
Process Connection:	1/2 in NPTF			
Protection:	Refractive			
Packing Material	Neoprene	Rating	300 deg F	
Hydraulic adapter	N/A			

COCKS

Type:	Offset	Integral Bonnet	Yes	<-
Gage connection	5/8 in suffing box			<-
Body Material	Bronze	Packng Material	Rubber	<-
Process Connection:	2 in CL150 flange			<-
Drain Connection:	1/8 in NPTF			<-
Ball Check Shutoff	Vertical lower/ horizontal upper valve			<-
Seat	Integral			<-
Max Pressure:	120 psi @ 200 deg F			<-
Model	N6A Straight Pattern			<-

NOTES

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Level Instrument
Gage Glasses and Cocks

DATA SHEET NO.			REV.
LG-4421			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project: **SVS Boiler Replacement**

TAG NO:	**LG-4421**	Hookup Drawing No:	J513	Loop Wiring Diagram:	N/A	<-
		Spec:	40 9500	Vessel Number:	N/A	<-
Asset No:		P&ID:	J703			<-
Service Description:	Filming Amine Tank Level Gauge			Manufacturer:	Penberthy	<-
				Model:	Tubular Glass Gage	<-
Safety Level	GS			Quality Assurance Level		<-

PROCESS CONDITIONS

Lower Fluid				Upper Fluid				Units	
Fluid:	Filming Amine			Fluid:	N/A			Inches	<-
Fluid Density @ Operating Temperature:	N/A			Fluid Density @ Operating Temperature:	N/A			lbm/in^3	<-
Viscosity @ Operating Temperature:	N/A			Viscosity @ Operating Temperature:	N/A				<-
% solids:	N/A	Dielectric Constant:	Water Based	% Solids:	N/A	Dielectric Constant:	Water		<-
Service:	Filming Amine	Critical:	N/A	Service:	N/A	Critical:	N/A		<-
Temperature Min:	32	Normal:	N/A	Max:	100			deg F	<-
Pressure Min:	Atm	Normal:	Height	Max:	atm			psig	<-
Area Classification:	N/A	Ambient Temperature Requirements:	100						<-

GLASS

Type:	Tubular Glass	Glass type:	Reflex	
Glass Diameter	5/8 in	Glass height	20 in	
Glass Grade	High Pressure	Pressure rating	355 psig	
Process Connection:	1/2 in NPTF			
Protection:	Refractive			
Packing Material	Neoprene	Rating	300 deg F	
Hydraulic adapter	N/A			

COCKS

Type:	Offset	Integral Bonnet	Yes	<-
Gage connection	5/8 in suffing box			<-
Body Material	Bronze	Packng Material	Rubber	<-
Process Connection:	2 in CL150 flange			<-
Drain Connection:	1/8 in NPTF			<-
Ball Check Shutoff	Vertical lower/ horizontal upper valve			<-
Seat	Integral			<-
Max Pressure:	120 psi @ 200 deg F			<-
Model	N6A Straight Pattern			<-

NOTES

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Level Instrument

Gage Glasses and Cocks

DATA SHEET NO.			REV.
LG-4441			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project: **SVS Boiler Replacement**

TAG NO:	**LG-4441**	Hookup Drawing No:	J513	Loop Wiring Diagram:	N/A	<-
		Spec:	40 9500	Vessel Number:	N/A	<-
Asset No:		P&ID:	J703			<-
Service Description:	Phosphate Tank Level Gauge			Manufacturer:	Penberthy	<-
				Model:	Tubular Glass Gage	<-
Safety Level	GS			Quality Assurance Level		<-

PROCESS CONDITIONS

Lower Fluid				Upper Fluid				Units	
Fluid:	Phosphate			Fluid:	N/A			Inches	<-
Fluid Density @ Operating Temperature:	N/A			Fluid Density @ Operating Temperature:	N/A			lbm/in^3	<-
Viscosity @ Operating Temperature:	N/A			Viscosity @ Operating Temperature:	N/A				<-
% solids:	N/A	Dielectric Constant:	Water Based	% Solids:	N/A	Dielectric Constant:	Water		<-
Service:	Phosphate	Critical:	N/A	Service:	N/A	Critical:	N/A		<-
Temperature Min:	32	Normal:	N/A	Max:	100			deg F	<-
Pressure Min:	Atm	Normal:	Height	Max:	atm			psig	<-
Area Classification:	N/A	Ambient Temperature Requirements:	100						<-

GLASS

Type:	Tubular Glass	Glass type:	Reflex	
Glass Diameter	5/8 in	Glass height	20 in	
Glass Grade	High Pressure	Pressure rating	355 psig	
Process Connection:	1/2 in NPTF			
Protection:	Refractive			
Packing Material	Neoprene	Rating	300 deg F	
Hydraulic adapter	N/A			

COCKS

Type:	Offset	Integral Bonnet	Yes	<-
Gage connection	5/8 in suffing box			<-
Body Material	Bronze	Packng Material	Rubber	<-
Process Connection:	2 in CL150 flange			<-
Drain Connection:	1/8 in NPTF			<-
Ball Check Shutoff	Vertical lower/ horizontal upper valve			<-
Seat	Integral			<-
Max Pressure:	120 psi @ 200 deg F			<-
Model	N6A Straight Pattern			<-

NOTES

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Level Instrument
Gage Glasses and Cocks

DATA SHEET NO.			REV.
LG-4461			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project: **SVS Boiler Replacement**

TAG NO:	**LG-4461**	Hookup Drawing No:	J513	Loop Wiring Diagram:	N/A	<-
		Spec:	40 9500	Vessel Number:	N/A	<-
Asset No:		P&ID:	J703			<-
Service Description:	NL-90 Tank Level Gauge			Manufacturer:	Penberthy	<-
				Model:	Tubular Glass Gage	<-
Safety Level	GS			Quality Assurance Level		<-

PROCESS CONDITIONS

Lower Fluid				Upper Fluid				Units	
Fluid:	NL-90			Fluid:	N/A			Inches	<-
Fluid Density @ Operating Temperature:	N/A			Fluid Density @ Operating Temperature:	N/A			lbm/in^3	<-
Viscosity @ Operating Temperature:	N/A			Viscosity @ Operating Temperature:	N/A				<-
% solids:	N/A	Dielectric Constant:	Water Based	% Solids:	N/A	Dielectric Constant:	Water		<-
Service:	NL-90	Critical:	N/A	Service:	N/A	Critical:	N/A		<-

Temperature Min:	32	Normal:	N/A	Max:	100	deg F	<-
Pressure Min:	Atm	Normal:	Height	Max:	atm	psig	<-
Area Classification:	N/A	Ambient Temperature Requirements:	100				<-

GLASS

Type:	Tubular Glass	Glass type:	Reflex	
Glass Diameter	5/8 in	Glass height	20 in	
Glass Grade	High Pressure	Pressure rating	355 psig	
Process Connection:	1/2 in NPTF			
Protection:	Refractive			
Packing Material	Neoprene	Rating	300 deg F	
Hydraulic adapter	N/A			

COCKS

Type:	Offset	Integral Bonnet	Yes	<-
Gage connection	5/8 in suffing box			<-
Body Material	Bronze	Packng Material	Rubber	<-
Process Connection:	2 in CL150 flange			<-
Drain Connection:	1/8 in NPTF			<-
Ball Check Shutoff	Vertical lower/ horizontal upper valve			<-
Seat	Integral			<-
Max Pressure:	120 psi @ 200 deg F			<-
Model	N6A Straight Pattern			<-

NOTES

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Level Instrument

Gage Glasses and Cocks

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
LG-5603			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: **SVS Boiler Replacement**

TAG NO:	**LG-5603**	Hookup Drawing No:	J513	Loop Wiring Diagram:	N/A	<-
		Spec:	40 9500	Vessel Number:	N/A	<-
Asset No:		P&ID:	J702			<-
Service Description:	Auxiliary Steam Boiler Tank Level Gauge (Sight Glass)			Manufacturer:	Penberthy	<-
				Model:	Tubular Glass Gage	<-
Safety Level	GS			Quality Assurance Level		<-

PROCESS CONDITIONS

Lower Fluid				Upper Fluid				Units	
Fluid:	Water			Fluid:	N/A			Percent	<-
Fluid Density @ Operating Temperature:	N/A			Fluid Density @ Operating Temperature:	N/A			lbm/in^3	<-
Viscosity @ Operating Temperature:	N/A			Viscosity @ Operating Temperature:	N/A				<-
% solids:	N/A	Dielectric Constant:	Water Based	% Solids:	N/A	Dielectric Constant:	Water		<-
Service:	AHW	Critical:	N/A	Service:	N/A	Critical:	N/A		<-
Temperature Min:	35	Normal:	N/A	Max:	Notes			deg F	<-
Pressure Min:	Atm	Normal:	Height + 7	Max:	Height + 150			psig	<-
Area Classification:	N/A	Ambient Temperature Requirements:	Notes						<-

GLASS

Type:	Tubular Glass	Glass type:	Reflex	
Glass Diameter	5/8 in	Glass height	20 in	
Glass Grade	High Pressure	Pressure rating	355 psig	
Process Connection:	1/2 in NPTF			
Protection:	Refractive			
Packing Material	Neoprene	Rating	300 deg F	
Hydraulic adapter	N/A			

COCKS

Type:	Offset	Integral Bonnet	Yes	<-
Gage connection	5/8 in suffing box			<-
Body Material	Bronze	Packng Material	Rubber	<-
Process Connection:	2 in CL150 flange			<-
Drain Connection:	1/8 in NPTF			<-
Ball Check Shutoff	Vertical lower/ horizontal upper valve			<-
Seat	Integral			<-
Max Pressure:	120 psi @ 200 deg F			<-
Model	N6A Straight Pattern			<-

NOTES

Manufacturer listing is for reference. Contractor will select an appropriate instrument to provide a complete system that is functional in all respects
Contractor will refer to selected Auxiliary Boiler and fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Level Instrument
Gage Glasses and Cocks

DATA SHEET NO.			REV.
LG-5710			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
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P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project: **SVS Boiler Replacement**

TAG NO:	**LG-5710**	Hookup Drawing No:	J513	Loop Wiring Diagram:	N/A	<-
		Spec:	40 9500	Vessel Number:	N/A	<-
Asset No:		P&ID:	J704			<-
Service Description:	Continuous Blowdown Tank Level Gauge (Sight Glass)			Manufacturer:	Penberthy	<-
				Model:	Tubular Glass Gage	<-
Safety Level	GS			Quality Assurance Level		<-

PROCESS CONDITIONS

Lower Fluid				Upper Fluid				Units	
Fluid:	Water			Fluid:	N/A			Percent	<-
Fluid Density @ Operating Temperature:	N/A			Fluid Density @ Operating Temperature:	N/A			lbm/in^3	<-
Viscosity @ Operating Temperature:	N/A			Viscosity @ Operating Temperature:	N/A				<-
% solids:	N/A	Dielectric Constant:	Water Based	% Solids:	N/A	Dielectric Constant:	Water		<-
Service:	CBD	Critical:	N/A	Service:	N/A	Critical:	N/A		<-
Temperature Min:	32	Normal:	N/A	Max:	350			deg F	<-
Pressure Min:	Atm	Normal:	Height + 7	Max:	Height + 150			psig	<-
Area Classification:	N/A	Ambient Temperature Requirements:	350						<-

GLASS

Type:	Tubular Glass	Glass type:	Reflex	
Glass Diameter	5/8 in	Glass height	20 in	
Glass Grade	High Pressure	Pressure rating	355 psig	
Process Connection:	1/2 in NPTF			
Protection:	Refractive			
Packing Material	Neoprene	Rating	300 deg F	
Hydraulic adapter	N/A			

COCKS

Type:	Offset	Integral Bonnet	Yes	<-
Gage connection	5/8 in suffing box			<-
Body Material	Bronze	Packng Material	Rubber	<-
Process Connection:	2 in CL150 flange			<-
Drain Connection:	1/8 in NPTF			<-
Ball Check Shutoff	Vertical lower/ horizontal upper valve			<-
Seat	Integral			<-
Max Pressure:	120 psi @ 200 deg F			<-
Model	N6A Straight Pattern			<-

NOTES

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Level Instrument

Gage Glasses and Cocks

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
LG-6622			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: **SVS Boiler Replacement**

TAG NO:	**LG-6622**	Hookup Drawing No:	J513	Loop Wiring Diagram:	N/A	<-
		Spec:	40 9500	Vessel Number:	TK-6	<-
Asset No:		P&ID:	J715			<-
Service Description:	Ammonia Diffusion Tank Level Gauge (Sight Glass)			Manufacturer:	Penberthy	<-
				Model:	Tubular Glass Gage	<-
Safety Level	GS			Quality Assurance Level		<-

PROCESS CONDITIONS

Lower Fluid				Upper Fluid				Units	
Fluid:	NH3 in Water			Fluid:	NH3 in Water			#N/A	<-
Fluid Density @ Operating Temperature:	N/A			Fluid Density @ Operating Temperature:	N/A			lbm/in^3	<-
Viscosity @ Operating Temperature:	N/A			Viscosity @ Operating Temperature:	N/A				<-
% solids:	N/A	Dielectric Constant:	Water Based	% Solids:	N/A	Dielectric Constant:	Water		<-
Service:	NH3	Critical:	N/A	Service:	N/A	Critical:	N/A		<-
Temperature Min:	35	Normal:	67.5	Max:	Water: 100; with NH3: up to 160			deg F	<-
Pressure Min:	0	Normal:	Height (~48" H2O)	Max:	Height (~48" H2O)			psig	<-
Area Classification:	N/A	Ambient Temperature Requirements:	35 to 100 F						<-

GLASS

Type:	Tubular Glass	Glass type:	Reflex	
Glass Diameter	5/8 in	Glass height	20 in	
Glass Grade	High Pressure	Pressure rating	355 psig	
Process Connection:	1/2 in NPTF			
Protection:	Refractive			
Packing Material	Neoprene	Rating	300 deg F	
Hydraulic adapter	N/A			

COCKS

Type:	Offset	Integral Bonnet	Yes	<-
Gage connection	5/8 in suffing box			<-
Body Material	Bronze	Packng Material	Rubber	<-
Process Connection:	2 in CL150 flange			<-
Drain Connection:	1/8 in NPTF			<-
Ball Check Shutoff	Vertical lower/ horizontal upper valve			<-
Seat	Integral			<-
Max Pressure:	120 psi @ 200 deg F			<-
Model	N6A Straight Pattern			<-

NOTES

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects. <-
Contractor will fill in remaining fields with data from the selected instrument. <-
<-
<-
<-

National Aeronautics and Space Administration
Ames Research Center

Level Detector
Float Switch

DATA SHEET NO.	REV.
LSH-4002	0

SHEET	OF	DATE
1	1	12-12-2012

BY	CHK'D	PROC.	APPR.
NCC	AME		

NO.	BY	DATE	REVISION

P.O.
REQ.

Project: SVS Boiler Replacement

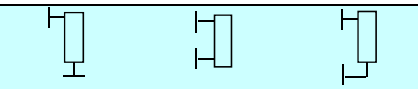
TAG NO:	**LSLL-4234**	Hookup Drawing No:	J504	Loop Wiring Diagram:	
		Spec:	40 9500	Vessel Number:	DAH-1
Asset No:		P&ID:	J702		
Service Description:	Feedwater Tank Level Switch Low, Low			Manufacturer:	Mercoid
				Model:	Series 123
Safety Class:	GS			N/A	
Quality Assurance Level:				N/A	

PROCESS CONDITIONS

Lower Fluid				Upper Fluid				Units
Fluid:	Water			Fluid:	Air			
Fluid Density @ Operating Temperature:	N/A			Fluid Density @ Operating Temperature:	N/A			lbm/in^3
Viscosity @ Operating Temperature:	N/A			Viscosity @ Operating Temperature:	N/A			
% Solids:	N/A	Dielectric Constant:	Water Based	% Solids:	N/A	Dielectric Constant:	N/A	
Service:	Water	Critical:	N/A	Service:	N/A	Critical:	N/A	
Temperature Min:	35	Normal:	232	Max:	275			deg F
Pressure Min:	atm	Normal:	7	Max:	30			psig
Area Classification:	N/A	Ambient Temperature Requirements:	100 deg F					

BODY / CAGE

Cage Type:	N/A		
Upper Connection Size:	N/A	Type:	N/A
Lower Connection Size:	N/A	Type:	N/A
Body / Cage Material:	N/A	Rating:	N/A
Rotatable Head:	N/A	Orientation:	N/A
Drain Valve:	N/A	Vent Valve:	N/A
Cage Length:	N/A	Diameter:	N/A
Nozzle Extension Length:	N/A		
Span Between Nozzles:	N/A		
Cooling Extension:	N/A		
Cage Mounting:			
N/A			



TRANSMITTER

Voltage:	24V DC				
Power Wiring:		Signal Type:	N/A		
Communication Protocal:	N/A	Location:			
Smart:	N/A	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	None	Temperature Category:			
Gas Group:	N/A	Encl Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	N/A				
Accuracy:	N/A				
Sensor Connection:	N/A				
Conduit Connection:	N/A				
Body Material:	N/A				
Calibrated Range:	N/A	Full Range:	N/A		
Gasket Material:	N/A	SS Tag:	LSLL-4234		

ELEMENT

Type:		Signal Gauge:	N/A
Gauge Material:	N/A	Gauge Dimensions:	N/A
Insertion Depth:	N/A		
Process Connection:	Immersion		
Radar Frequency:	N/A		
Displacer Extension:	N/A		
Displacer Spring / Tube Material:	N/A		
Float Well Clearance:	N/A	Float Shaft Clearance:	N/A

SWITCHES

RELAY 1	Tag No:	LSLL-4234			
	Power Rating:	SEE NOTES	Type:	N/C	
	Alarm Setting:	N/A			
RELAY 2	Tag No:	N/A			
	Power Rating:	SEE NOTES	Type:	N/A	
	Alarm Setting:	N/A			
Contact Rating:	N/A	Contact Form:	N/A		
Conduit Connection:					
Manufacturer:					
Model No.	See Notes				
Electrical Protection:	N/A	Temperature Category:	T6		
Gas Group:	N/A	Enclosure Protection:	EE NOTE		N/A

NOTES

NEMA 4X

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

Element Tag	LSLL-4234
Remote Indicator Tag	N/A

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
LT-4230			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**LT-4230**	Hookup Drawings:	J509/510	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	DAH-1		
Asset No:		P&ID:	J702	Line ID:		Size: -	Schedule:
Service Description:	Feedwater Tank Level Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Water					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	Height + 7psig	Max:	Height + 30psig	Oper:	7	Max:	30	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	232	Max:	275	Min:	35	Normal:	232	Max:	275	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	BFW	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	275					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	LT-4230		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
LT-5710			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**LT-5710**	Hookup Drawings:	J509/510	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	DAH-1		
Asset No:		P&ID:	J704	Line ID:		Size: -	Schedule:
Service Description:	Continuous Blowdown Tank Level Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Water					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	Height + 7psig	Max:	Height + 30psig	Oper:	7	Max:	30	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	232	Max:	350	Min:	35	Normal:	232	Max:	275	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	CBD	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	350					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	LT-5710		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
LT-6606			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**LT-6606**	Hookup Drawings:	J509/510	Loop Wiring Diagrams:							
		Spec No:	40 9500	Line / Vessel Number:	TK-5						<-
Asset No:		P&ID:	J715	Line ID:		Size:	N/A	Schedule:			<-
Service Description:	Anhydrous Ammonia Tank Level Transmitter			Manufacturer:	Yokogawa						<-
				Model:	EJA530AE						<-
Safety Class:	GS			Quality Assurance Level							<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection					Units:
Fluid:	Anhydrous Ammonia					Fluid:	Water				
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Low:	N/A	Oper:	Height + 140	Max:	Height + 265 psig	Oper:	140	Max:	265	H2OTst:	N/A psig
Temperature:						Temperature:					
Min:	35	Normal:	67.5	Max:	100	Min:	35	Normal:	67.5	Max:	100 F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	NH3	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requiremen	N/A				

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	LT-6606		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-3009			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PI-3009**	Hookup Drawings:	J503	Loop Wiring Diagrams:						rev	
		Spec No:	40 9500	Line / Vessel Number:	N/A						<-
Asset No:		P&ID:	J714	Line ID:		Size (in):	8	Schedule:			<-
Service Description:	Natural Gas Supply Local Pressure Indicator			Manufacturer:	Ascroft						<-
				Model:	451279						<-
Safety Class:	GS			Quality Assurance Level							<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection					Units:
Fluid:	Nat Gas					Fluid:	N/A				
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Low:		High:	50	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A psig
Temperature:						Temperature:					
Min:	35	Normal:	67.5	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	MPG	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requirements:	100				

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A		Signal Type:	N/A	
Communication Protocol:	N/A		Location:	N/A	
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A		Temperature Category:	N/A	
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A		Calibrated Range:	N/A	
Over Range:	N/A		Zero Elevation:	N/A	
Accuracy:	N/A		Gasket Material:	N/A	
Conduit Connection:	N/A		NACE:	N/A	
Element Connection:	N/A		SS Tag:	PI-3009	
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage

45 - 4.5" dial

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-4006			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	PI-4006	Hookup Drawings:	#N/A	Loop Wiring Diagrams:						rev	
		Spec No:	40 9500	Line / Vessel Number:	N/A						<-
Asset No:		P&ID:	J701	Line ID:		Size (in):	6	Schedule:			<-
Service Description:	Reverse Osmosis Water Supply Pressure (Before Flow Control Valve)			Manufacturer:	Ascroft						<-
				Model:	451279						<-
Safety Class:	GS			Quality Assurance Level							<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	N/A					
Fluid Density @ Operating Temp:		N/A				Fluid Density@ Operating Temp:		N/A				lbm/in3
Viscosity @ Operating Temp:		N/A				Viscosity @ Operating Temp:		N/A				N/A
Pressure:						Pressure:						
Low:		High:	100	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	#N/A
Temperature:						Temperature:						
Min:	35	Normal:	67.5	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:		N/A		% solids:	N/A		% Quality:	N/A		
Service:	RO	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:		N/A				Ambient Temperature Requiremer			100			

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A		Signal Type:	N/A	
Communication Protoco	N/A		Location:	N/A	
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A		Temperature Category:	N/A	
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A		Calibrated Range:	N/A	
Over Range:	N/A		Zero Elevation:	N/A	
Accuracy:	N/A		Gasket Material:	N/A	
Conduit Connection:	N/A		NACE:	N/A	
Element Connection:	N/A		SS Tag:	PI-4006	
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-4008			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PI-4008**	Hookup Drawings:	#N/A	Loop Wiring Diagrams:						rev <-
		Spec No:	40 9500	Line / Vessel Number:	N/A					<-
Asset No:		P&ID:	J701	Line ID:		Size (in):	6	Schedule:		<-
Service Description:	Reverse Osmosis Water Supply Pressure (After Flow Control Valve)			Manufacturer:	Ascroft					<-
				Model:	451279					<-
Safety Class:	GS			Quality Assurance Level						<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	N/A					
Fluid Density @ Operating Temp:		N/A				Fluid Density@ Operating Temp:		N/A				lbm/in3
Viscosity @ Operating Temp:		N/A				Viscosity @ Operating Temp:		N/A				N/A
Pressure:						Pressure:						
Low:		High:	100	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	#N/A
Temperature:						Temperature:						
Min:	35	Normal:	67.5	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:		N/A		% solids:	N/A		% Quality:	N/A		
Service:	RO	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:		N/A				Ambient Temperature Requiremen		100				

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A		Signal Type:	N/A	
Communication Protoco	N/A		Location:	N/A	
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A		Temperature Category:	N/A	
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A		Calibrated Range:	N/A	
Over Range:	N/A		Zero Elevation:	N/A	
Accuracy:	N/A		Gasket Material:	N/A	
Conduit Connection:	N/A		NACE:	N/A	
Element Connection:	N/A		SS Tag:	PI-4008	
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial

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National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-4141			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PI-4141**	Hookup Drawings:	J503	Loop Wiring Diagrams:							<-
		Spec No:	40 9500	Line / Vessel Number:	N/A						<-
Asset No:		P&ID:	J704	Line ID:		Size (in):	1.5	Schedule:			<-
Service Description:	Softened Water to HX-2 Inlet Local Pressure Indicator			Manufacturer:	Ascroft						<-
				Model:	451279						<-
Safety Class:	GS			Quality Assurance Level							<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:	
Fluid:	Water					Fluid:	N/A						<-
Fluid Density @ Operating Temp:		N/A				Fluid Density@ Operating Temp:		N/A				lbm/in3	<-
Viscosity @ Operating Temp:		N/A				Viscosity @ Operating Temp:		N/A				N/A	<-
Pressure:						Pressure:							<-
Low:		High:	100	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig	<-
Temperature:						Temperature:							<-
Min:	35	Normal:	67.5	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F	<-
% solids:	N/A	% Quality:		N/A		% solids:	N/A		% Quality:	N/A			<-
Service:	SPW	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A		<-
Area Classification:		N/A				Ambient Temperature Requiremen		100					<-

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protoco	N/A	Location:	N/A		
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A	Calibrated Range:	N/A		
Over Range:	N/A	Zero Elevation:	N/A		
Accuracy:	N/A	Gasket Material:	N/A		
Conduit Connection:	N/A	NACE:	N/A		
Element Connection:	N/A	SS Tag:	PI-4141		
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial

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National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-4144			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PI-4144**	Hookup Drawings:	J503	Loop Wiring Diagrams:							
		Spec No:	40 9500	Line / Vessel Number:	N/A						<-
Asset No:		P&ID:	J704	Line ID:		Size (in):	1.5	Schedule:			<-
Service Description:	Softened Water from HX-2 Outlet Local Pressure Indicator			Manufacturer:	Ascroft						<-
				Model:	451279						<-
Safety Class:	GS			Quality Assurance Level							<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	N/A					
Fluid Density @ Operating Temp:		N/A				Fluid Density@ Operating Temp:		N/A				lbm/in3
Viscosity @ Operating Temp:		N/A				Viscosity @ Operating Temp:		N/A				N/A
Pressure:						Pressure:						
Low:		High:	100	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	67.5	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:		N/A		% solids:	N/A		% Quality:	N/A		
Service:	SPW	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:		N/A				Ambient Temperature Requiremer			100			

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protoco	N/A	Location:	N/A		
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A	Calibrated Range:	N/A		
Over Range:	N/A	Zero Elevation:	N/A		
Accuracy:	N/A	Gasket Material:	N/A		
Conduit Connection:	N/A	NACE:	N/A		
Element Connection:	N/A	SS Tag:	PI-4144		
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-4206			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PI-4206**	Hookup Drawings:	J503	Loop Wiring Diagrams:								rev <-
		Spec No:	40 9500	Line / Vessel Number:	N/A							<-
Asset No:		P&ID:	J702	Line ID:		Size (in):	16	Schedule:				<-
Service Description:	Steam Recovery to Deaerator Local Pressure Indicator			Manufacturer:	Ascroft							<-
				Model:	451279							<-
Safety Class:	GS			Quality Assurance Level								<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Steam					Fluid:	N/A					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:		High:	20	Max:	7	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	132.5	Max:	230	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	LPS	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	230					

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	N/A		
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A	Calibrated Range:	N/A		
Over Range:	N/A	Zero Elevation:	N/A		
Accuracy:	N/A	Gasket Material:	N/A		
Conduit Connection:	N/A	NACE:	N/A		
Element Connection:	N/A	SS Tag:	PI-4206		
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-5601			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: **SVS Boiler Replacement**

TAG NO:	**PI-5601**	Hookup Drawings:	J503	Loop Wiring Diagrams:						rev	<-
		Spec No:	40 9500	Line / Vessel Number:	N/A						<-
Asset No:		P&ID:	J702	Line ID:		Size (in):	-	Schedule:			<-
Service Description:	Auxiliary Steam Boiler Local Pressure Indicator			Manufacturer:	Ascroft						<-
				Model:	451279						<-
Safety Class:	GS			Quality Assurance Level							<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection					Units:
Fluid:	Steam					Fluid:	N/A				
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Low:		High:	Notes	Max:	Notes	Oper:	N/A	Design:	N/A	H2OTst:	N/A psig
Temperature:						Temperature:					
Min:	35	Normal:	Notes	Max:	Notes	Min:	N/A	Normal:	N/A	Max:	N/A F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	CBD	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Reqs:	Notes				

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A		Signal Type:	N/A	
Communication Protocol:	N/A		Location:	N/A	
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A		Temperature Category:	N/A	
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A		Calibrated Range:	N/A	
Over Range:	N/A		Zero Elevation:	N/A	
Accuracy:	N/A		Gasket Material:	N/A	
Conduit Connection:	N/A		NACE:	N/A	
Element Connection:	N/A		SS Tag:	PI-5601	
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will refer to selected Auxiliary Boiler and fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-5713			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PI-5713**	Hookup Drawings:	J503	Loop Wiring Diagrams:						rev	<-
		Spec No:	40 9500	Line / Vessel Number:	N/A						<-
Asset No:		P&ID:	J704	Line ID:		Size (in):	-	Schedule:			<-
Service Description:	Continuous Blowdown Tank Local Pressure Indicator			Manufacturer:	Ascroft						<-
				Model:	451279						<-
Safety Class:	GS			Quality Assurance Level							<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection					Units:
Fluid:	Water					Fluid:	N/A				
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Low:		High:	15	Max:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A psig
Temperature:						Temperature:					
Min:	35	Normal:	192.5	Max:	350	Min:	N/A	Normal:	N/A	Max:	N/A F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	CBD	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requirements:	350				

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	N/A		
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A	Calibrated Range:	N/A		
Over Range:	N/A	Zero Elevation:	N/A		
Accuracy:	N/A	Gasket Material:	N/A		
Conduit Connection:	N/A	NACE:	N/A		
Element Connection:	N/A	SS Tag:	PI-5713		
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-5720			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PI-5720**	Hookup Drawings:	J503	Loop Wiring Diagrams:							<-
		Spec No:	40 9500	Line / Vessel Number:	N/A						<-
Asset No:		P&ID:	J704	Line ID:		Size (in):	-	Schedule:			<-
Service Description:	Blowdown Heat Recovery Inlet Local Pressure Indicator			Manufacturer:	Ascroft						<-
				Model:	451279						<-
Safety Class:	GS			Quality Assurance Level							<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	N/A					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:		High:	15	Max:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	155	Max:	275	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	CBD	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requiremer	275					

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protoco	N/A	Location:	N/A		
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A	Calibrated Range:	N/A		
Over Range:	N/A	Zero Elevation:	N/A		
Accuracy:	N/A	Gasket Material:	N/A		
Conduit Connection:	N/A	NACE:	N/A		
Element Connection:	N/A	SS Tag:	PI-5720		
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-5721			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PI-5721**	Hookup Drawings:	J503	Loop Wiring Diagrams:					rev <-
		Spec No:	40 9500	Line / Vessel Number:	N/A				<-
Asset No:		P&ID:	J704	Line ID:		Size (in):	-	Schedule:	<-
Service Description:	Blowdown Heat Recovery Outlet Local Pressure Indicator			Manufacturer:	Ascroft				<-
				Model:	451279				<-
Safety Class:	GS			Quality Assurance Level					<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection					Units:
Fluid:	Water					Fluid:	N/A				
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Low:		High:	15	Max:	150	Oper:	N/A	Design:	N/A	H2OTst:	N/A psig
Temperature:						Temperature:					
Min:	35	Normal:	155	Max:	275	Min:	N/A	Normal:	N/A	Max:	N/A F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	CBD	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requirements:	275				

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A		Signal Type:	N/A	
Communication Protocol:	N/A		Location:	N/A	
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A		Temperature Category:	N/A	
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A		Calibrated Range:	N/A	
Over Range:	N/A		Zero Elevation:	N/A	
Accuracy:	N/A		Gasket Material:	N/A	
Conduit Connection:	N/A		NACE:	N/A	
Element Connection:	N/A		SS Tag:	PI-5721	
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-5806			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: **SVS Boiler Replacement**

TAG NO:	**PI-5806**	Hookup Drawings:	J503	Loop Wiring Diagrams:						rev	
		Spec No:	40 9500	Line / Vessel Number:	N/A						<-
Asset No:		P&ID:	J707	Line ID:		Size (in):	10	Schedule:			<-
Service Description:	SVS Pressure Reducing Station Local Pressure Indicator			Manufacturer:	Ascroft						<-
				Model:	451279						<-
Safety Class:	GS			Quality Assurance Level							<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection					Units:
Fluid:	Steam					Fluid:	N/A				
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Low:		High:	550	Max:	500	Oper:	N/A	Design:	N/A	H2OTst:	N/A psig
Temperature:						Temperature:					
Min:	35	Normal:	252.5	Max:	470	Min:	N/A	Normal:	N/A	Max:	N/A F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	SVS	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requirements:	470				

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protocol:	N/A	Location:	N/A		
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A	Calibrated Range:	N/A		
Over Range:	N/A	Zero Elevation:	N/A		
Accuracy:	N/A	Gasket Material:	N/A		
Conduit Connection:	N/A	NACE:	N/A		
Element Connection:	N/A	SS Tag:	PI-5806		
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-5832			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PI-5832**	Hookup Drawings:	J503	Loop Wiring Diagrams:						rev	<-
		Spec No:	40 9500	Line / Vessel Number:	N/A						<-
Asset No:		P&ID:	J707	Line ID:		Size (in):	8	Schedule:			<-
Service Description:	Steam Recovery to Deaerator Local Pressure Indicator			Manufacturer:	Ascroft						<-
				Model:	451279						<-
Safety Class:	GS			Quality Assurance Level							<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection					Units:
Fluid:	Steam					Fluid:	N/A				
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Low:		High:	20	Max:	7	Oper:	N/A	Design:	N/A	H2OTst:	N/A psig
Temperature:						Temperature:					
Min:	35	Normal:	132.5	Max:	230	Min:	N/A	Normal:	N/A	Max:	N/A F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	AUX	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requirements:	230				

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A		Signal Type:	N/A	
Communication Protocol:	N/A		Location:	N/A	
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A		Temperature Category:	N/A	
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A		Calibrated Range:	N/A	
Over Range:	N/A		Zero Elevation:	N/A	
Accuracy:	N/A		Gasket Material:	N/A	
Conduit Connection:	N/A		NACE:	N/A	
Element Connection:	N/A		SS Tag:	PI-5832	
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial

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Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-6601			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PI-6601**	Hookup Drawings:	J503	Loop Wiring Diagrams:							<-
		Spec No:	40 9500	Line / Vessel Number:	TK-5						<-
Asset No:		P&ID:	J715	Line ID:		Size (in):	N/A	Schedule:			<-
Service Description:	Anhydrous Ammonia Tank Local Pressure Indicator			Manufacturer:	Ascroft						<-
				Model:	451279						<-
Safety Class:	GS			Quality Assurance Level							<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Anhydrous Ammonia					Fluid:	N/A					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	60	High:	140	Max:	265	Oper:	N/A	Design:	N/A	H2OTst:	N/A	#N/A
Temperature:						Temperature:						
Min:	35	Normal:	67.5	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	NH3	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requiremer	100 F					

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Communication Protoco	N/A	Location:	N/A		
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A	Calibrated Range:	N/A		
Over Range:	N/A	Zero Elevation:	N/A		
Accuracy:	N/A	Gasket Material:	N/A		
Conduit Connection:	N/A	NACE:	N/A		
Element Connection:	N/A	SS Tag:	PI-6601		
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-6741			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PI-6741**	Hookup Drawings:	J503	Loop Wiring Diagrams:							rev <-
		Spec No:	40 9500	Line / Vessel Number:	N/A						<-
Asset No:		P&ID:	J714	Line ID:		Size (in):	1.5	Schedule:			<-
Service Description:	Shop Air From N231 Receiver Tank Local Pressure Indicator			Manufacturer:	Ascroft						<-
				Model:	451279						<-
Safety Class:	GS			Quality Assurance Level							<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection					Units:
Fluid:	Air					Fluid:	N/A				
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Low:		High:	180	Max:	180	Oper:	N/A	Design:	N/A	H2OTst:	N/A psig
Temperature:						Temperature:					
Min:	35	Normal:	67.5	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requirements:	100				

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A		Signal Type:	N/A	
Communication Protocol:	N/A		Location:	N/A	
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A		Temperature Category:	N/A	
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A		Calibrated Range:	N/A	
Over Range:	N/A		Zero Elevation:	N/A	
Accuracy:	N/A		Gasket Material:	N/A	
Conduit Connection:	N/A		NACE:	N/A	
Element Connection:	N/A		SS Tag:	PI-6741	
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Indicator

C-Type Bourdon Tube Gauge

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PI-6751			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PI-6751**	Hookup Drawings:	J503	Loop Wiring Diagrams:						rev	
		Spec No:	40 9500	Line / Vessel Number:	N/A						<-
Asset No:		P&ID:	J714	Line ID:		Size (in):	1.5	Schedule:			<-
Service Description:	Instrument Air From N229A Receiver Tank Local Pressure Indicator			Manufacturer:	Ascroft						<-
				Model:	451279						<-
Safety Class:	GS			Quality Assurance Level							<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection					Units:
Fluid:	Air					Fluid:	N/A				
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A				lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A				N/A
Pressure:						Pressure:					
Low:		High:	180	Max:	180	Oper:	N/A	Design:	N/A	H2OTst:	N/A psig
Temperature:						Temperature:					
Min:	35	Normal:	67.5	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A		
Service:	IA	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A
Area Classification:	N/A					Ambient Temperature Requirements:	100				

ELEMENT

Type:			
Fill Fluid:	N/A		
Min Range:		Max Range:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

GAUGE

Voltage:	N/A				
Power Wiring:	N/A		Signal Type:	N/A	
Communication Protocol:	N/A		Location:	N/A	
Smart:	N/A	Indicate:	4.5 in.	Isolate:	Yes
Electrical Protection:	N/A		Temperature Category:	N/A	
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Factory Calibration:	Yes				
Ambient Temperature Compensation:	N/A				
Characteristic:	N/A		Calibrated Range:	N/A	
Over Range:	N/A		Zero Elevation:	N/A	
Accuracy:	N/A		Gasket Material:	N/A	
Conduit Connection:	N/A		NACE:	N/A	
Element Connection:	N/A		SS Tag:	PI-6751	
Body Max Pressure Rating:	N/A				
Body/Flange Material:					
Mounting:	N/A				

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:		Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:			N/A
Thickness:			N/A
Material:			N/A
Flush Ring:			N/A
Process Connection:			
Max Temperature:			
Pressure Rating:	N/A		
Max Pressure:			
Manufacturer:			
Model:			

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

1279 - Pressure Guage
45 - 4.5" dial

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-4009			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PIT-4009**	Hookup Drawings:	J501/502	Loop Wiring Diagrams:		
		Spec No:	40 9500	Line / Vessel Number:	N/A	<-
Asset No:		P&ID:	J701	Line ID:	Size: 6 Schedule:	<-
Service Description:	Reverse Osmosis Water Supply Pressure Indicating Transmitter (After Flow Indicator)			Manufacturer:	Yokogawa	<-
				Model:	EJA530AE	<-
Safety Class:	GS			Quality Assurance Level		<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	100	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	67.5	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	MU	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4009		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-4071			0
SHEET	OF	DATE	
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NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	PIT-4071	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J701	Line ID:		Size: 6	Schedule:
Service Description:	Water Softener Inlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	100	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	MU	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4071		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-4104			0
SHEET	OF	DATE	
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NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	PIT-4104	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J701	Line ID:		Size: 6	Schedule:
Service Description:	Hot Well Heat Recovery Pump Inlet Pressure Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	100	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	SCW	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4104		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-4105			0
SHEET	OF	DATE	
1	1	12-12-2012	
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NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	PIT-4105	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J701	Line ID:		Size: 6	Schedule:
Service Description:	Hot Well Heat Recovery Pump Outlet Pressure Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	100	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	SCW	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4105		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-4134			0
SHEET	OF	DATE	
1	1	12-12-2012	
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NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PIT-4134**	Hookup Drawings:	J501/502	Loop Wiring Diagrams:		
		Spec No:	40 9500	Line / Vessel Number:	N/A	<-
Asset No:		P&ID:	J704	Line ID:	Size: 1.5 Schedule:	<-
Service Description:	Blowdown Pump HXP-2 Inlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa	<-
				Model:	EJA530AE	<-
Safety Class:	GS			Quality Assurance Level		<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	100	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	SPW	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4134		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-4135			0
SHEET	OF	DATE	
1	1	12-12-2012	
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NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PIT-4135**	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J704	Line ID:		Size: 1.5	Schedule:
Service Description:	Blowdown Pump HXP-2 Outlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	100	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	SPW	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4135		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.		REV.
PIT-4231		0
SHEET	OF	DATE
1	1	12-12-2012
BY	CHK'D	PROC. APPR.
NCC	AME	
P.O.		
REQ.		

Project: SVS Boiler Replacement

TAG NO:	**PIT-4231**	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J702	Line ID:		Size: -	Schedule:
Service Description:	Feedwater Tank Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	35	Max:	30	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	172.5	Max:	275	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	BFW	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	275					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4231		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.		REV.
PIT-4304		0
SHEET	OF	DATE
1	1	12-12-2012
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NCC	AME	
P.O.		
REQ.		

Project: SVS Boiler Replacement

TAG NO:	**PIT-4304**	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J706	Line ID:		Size: 6	Schedule:
Service Description:	Boiler FW Pump 1 Inlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	40	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	172	Max:	274	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	BFS	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	274					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4304		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.		REV.
PIT-4305		0
SHEET	OF	DATE
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NCC	AME	
P.O.		
REQ.		

Project: SVS Boiler Replacement

TAG NO:	**PIT-4305**	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J706	Line ID:		Size: 4	Schedule:
Service Description:	Boiler FW Pump 1 Outlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	1000	Max:	800	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	220	Max:	370	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	BFW	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	370					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4305		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.		REV.
PIT-4334		0
SHEET	OF	DATE
1	1	12-12-2012
BY	CHK'D	PROC. APPR.
NCC	AME	
P.O.		
REQ.		

Project: SVS Boiler Replacement

TAG NO:	**PIT-4334**	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J706	Line ID:		Size: 6	Schedule:
Service Description:	Boiler FW Pump 2 Inlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	40	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	172	Max:	274	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	BFS	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	274					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4334		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.		REV.
PIT-4335		0
SHEET	OF	DATE
1	1	12-12-2012
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NCC	AME	
P.O.		
REQ.		

Project: SVS Boiler Replacement

TAG NO:	**PIT-4335**	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J706	Line ID:		Size: 4	Schedule:
Service Description:	Boiler FW Pump 2 Outlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	1000	Max:	800	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	220	Max:	370	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	BFW	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	370					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4335		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-4364			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	PIT-4364	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J706	Line ID:		Size: 6	Schedule:
Service Description:	Boiler FW Pump 3 Inlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	40	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	172	Max:	274	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	BFS	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	274					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4364		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-4365			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	PIT-4365	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J706	Line ID:		Size: 4	Schedule:
Service Description:	Boiler FW Pump 3 Outlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	1000	Max:	800	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	220	Max:	370	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	BFW	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	370					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4365		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-4406			0
SHEET	OF	DATE	
1	1	12-12-2012	
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NCC	AME		
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REQ.			

Project: SVS Boiler Replacement

TAG NO:	PIT-4406	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J703	Line ID:		Size: 0.25	Schedule:
Service Description:	Sulfite Pump CFP-1 Outlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Sulfite					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	40	Max:	-	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	Sulfite	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4406		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-4426			0
SHEET	OF	DATE	
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REQ.			

Project: SVS Boiler Replacement

TAG NO:	PIT-4426	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J703	Line ID:		Size: 0.25	Schedule:
Service Description:	Filming Amine Pump CFP-2A Outlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Filming Amine					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:		N/A				Fluid Density@ Operating Temp:		N/A				lbm/in3
Viscosity @ Operating Temp:		N/A				Viscosity @ Operating Temp:		N/A				N/A
Pressure:						Pressure:						
Low:	0	High:	40	Max:	-	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	Filming Amine	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:			100			

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4426		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-4436			0
SHEET	OF	DATE	
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REQ.			

Project: SVS Boiler Replacement

TAG NO:	PIT-4436	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J703	Line ID:		Size: 0.25	Schedule:
Service Description:	Filming Amine Pump CFP-2B Outlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Filming Amine					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:		N/A				Fluid Density@ Operating Temp:		N/A				lbm/in3
Viscosity @ Operating Temp:		N/A				Viscosity @ Operating Temp:		N/A				N/A
Pressure:						Pressure:						
Low:	0	High:	750	Max:	-	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	Filming Amine	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:			100			

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4436		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-4446			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	PIT-4446	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J703	Line ID:		Size: 0.25	Schedule:
Service Description:	Phosphate Pump CFP-3A Outlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Phosphate					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	750	Max:	-	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	Phosphate	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4446		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-4456			0
SHEET	OF	DATE	
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NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	PIT-4456	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J703	Line ID:		Size: 0.25	Schedule:
Service Description:	Phosphate Pump CFP-3B Outlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Phosphate					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	750	Max:	-	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	Phosphate	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4456		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-4476			0
SHEET	OF	DATE	
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NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PIT-4476**	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J703	Line ID:		Size: 0.25	Schedule:
Service Description:	NL-90 Pump CFP-4B Outlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	NL-90					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	750	Max:	-	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	NL-90	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-4476		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter

E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.

Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-5623			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	PIT-5623	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J702	Line ID:		Size: -	Schedule:
Service Description:	Auxiliary Hot Water Pump BFP-4 Inlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	40	Max:	160	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	160	Max:	250	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	AHW	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	250					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-5623		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PIT-5624			0
SHEET	OF	DATE	
1	1	12-12-2012	
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NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PIT-5624**	Hookup Drawings:	J501/502	Loop Wiring Diagrams:		
		Spec No:	40 9500	Line / Vessel Number:	N/A	<-
Asset No:		P&ID:	J702	Line ID:	Size: - Schedule:	<-
Service Description:	Auxiliary Hot Water Pump BFP-4 Outlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa	<-
				Model:	EJA530AE	<-
Safety Class:	GS			Quality Assurance Level		<-

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	100	Max:	160	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	160	Max:	250	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	AHW	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	250					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PIT-5624		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PT-3010			0
SHEET	OF	DATE	
1	1	12-12-2012	
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NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PT-3010**	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J714	Line ID:	Size: 8	Schedule:	
Service Description:	Natural Gas Supply Pressure Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Nat Gas					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	50	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	MPG	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PT-3010		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PT-3100			0
SHEET	OF	DATE	
1	1	12-12-2012	
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NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PT-3100**	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J709	Line ID:		Size: 6	Schedule:
Service Description:	Natural Gas Supply to Boiler 1 Pressure Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Nat Gas					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	50	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	G	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PT-3100		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PT-3200			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
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P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	PT-3200	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J711	Line ID:		Size: 6	Schedule:
Service Description:	Natural Gas Supply to Boiler 2 Pressure Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Nat Gas					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	50	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	G	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PT-3200		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PT-3300			0
SHEET	OF	DATE	
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REQ.			

Project: SVS Boiler Replacement

TAG NO:	PT-3300	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J713	Line ID:		Size: 6	Schedule:
Service Description:	Natural Gas Supply to Boiler 3 Pressure Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Nat Gas					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	50	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	G	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PT-3300		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PT-4081			0
SHEET	OF	DATE	
1	1	12-12-2012	
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NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	PT-4081	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J701	Line ID:		Size: 6	Schedule:
Service Description:	Water Softener Outlet Pressure Indicating Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Water					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	100	Max:	100	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	SCW	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PT-4081		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PT-4207			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PT-4207**	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J702	Line ID:		Size: 16	Schedule:
Service Description:	Steam Recovery to Deaerator Pressure Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Steam					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	20	Max:	7	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	150	Max:	230	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	LPS	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	230					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PT-4207		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PT-5807			0
SHEET	OF	DATE	
1	1	12-12-2012	
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NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	PT-5807	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J707	Line ID:		Size: 10	Schedule:
Service Description:	SVS Pressure Reducing Station Pressure Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Steam					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	550	Max:	500	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	270	Max:	470	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	SVS	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	470					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PT-5807		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PT-6742			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**PT-6742**	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J714	Line ID:		Size: 1.5	Schedule:
Service Description:	Shop Air From N231 Receiver Tank Pressure Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Air					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	180	Max:	180	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	A	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PT-6742		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument

National Aeronautics and Space Administration
Ames Research Center

Pressure Instrument

Flow, Level, Pressure, and Differential Pressure

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
PT-6752			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	PT-6752	Hookup Drawings:	J501/502	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J714	Line ID:		Size: 1.5	Schedule:
Service Description:	Instrument Air From N229A Receiver Tank Pressure Transmitter			Manufacturer:	Yokogawa		
				Model:	EJA530AE		
Safety Class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Hi Pressure Connection:						Low Pressure Connection						Units:
Fluid:	Air					Fluid:	Atmosphere					
Fluid Density @ Operating Temp:	N/A					Fluid Density@ Operating Temp:	N/A					lbm/in3
Viscosity @ Operating Temp:	N/A					Viscosity @ Operating Temp:	N/A					N/A
Pressure:						Pressure:						
Low:	0	High:	180	Max:	180	Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig
Temperature:						Temperature:						
Min:	35	Normal:	85	Max:	100	Min:	N/A	Normal:	N/A	Max:	N/A	F
% solids:	N/A	% Quality:	N/A			% solids:	N/A	% Quality:	N/A			
Service:	IA	Critical:	N/A	Pulsating:	N/A	Service:	N/A	Critical:	N/A	Pulsating:	N/A	
Area Classification:	N/A					Ambient Temperature Requirements:	100					

ELEMENT

Type:			
Fill Fluid:			
Min Span:		Max Span:	
Diaphragm/Wetted Material:			
Vent/Drain Location:	N/A		
Vent/Drain Material:	N/A		
Process Connection:			

TRANSMITTER

Voltage:	24V dc				
Power Wiring:	Loop	Signal Type:	4-20mA		
Communication Protocol	HART	Location:	Local		
Smart:	Yes	Indicate:	Yes	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	6	IP2:	7
Factory Calibration:	Yes				
Ambient Temperature Compensation:	+/- [0.15%span + 0.15%Max]				
Characteristic:	N/A	Calibrated Range:			
Over Range:		Zero Elevation:	N/A		
Accuracy:	+/-0.2% span	Gasket Material:			
Conduit Connection:		NACE:	N/A		
Element Connection:	none	SS Tag:	PT-6752		
Body Max Pressure Rating:					
Body/Flange Material:					
Mounting:					

SEAL DIAPHRAM & CAPILLARY

Length:	N/A	ID:	N/A
Armor:	N/A		
Fill Fluid:	N/A	Max Response Time:	N/A
SG @ 60 °F:	N/A	Capilary Material:	N/A
Diaphragm:	Hi Press:		Low Press:
Size & Type:	N/A		N/A
Thickness:	N/A		N/A
Material:	N/A		N/A
Flush Ring:	N/A		N/A
Temperature Rating:	N/A		
Max Temperature:	N/A		
Pressure Rating:	N/A		
Max Pressure:	N/A		
Manufacturer:	N/A		
Model:	N/A		

MANIFOLD

Type:	N/A
Material:	N/A
Transmitter Connection:	N/A
Process Connection:	N/A
Manufacturer:	N/A
Model:	N/A

NOTES

EJA530A - Guage Pressure Transmitter
E - 4-20 mA DC with Hart protocol

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Temperature Instruments

Transmitters, Thermowells, RTDs, TCs

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
TE-4233			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: **SVS Boiler Replacement**

TAG NO:	**TE-4233**	Hookup Drawings:	J506/507	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		<-
Asset No:		P&ID:	J702	Line ID:		Size: -	Schedule: <-
Service Description:	Feedwater Tank Temperature Element			Manufacturer:	WIKA		<-
				Model:	AK		<-
Safety class:	GS			Quality Assurance Level			<-

PROCESS CONDITIONS

Pressure:						Units	Fluid:	Water		
Oper:	0	Design:	1	H2OTst:	30	psig	Area Classification:	N/A		
Temperature:							Ambient Temperature Requirements:	275		
Min:	0	Normal:	250	Max:	275	F	Service:	BFW	Critical:	N/A
Flow:										
Min:	N/A	Normal:	N/A	Max:	N/A	gpm				

THERMOWELL

Tag Name:	TW-4233		
Type:		NACE:	N/A
Process Connection:			
Element Connection:			
Vibration Calculation:	N/A		
Max Pressure Rating:			
Material:			
Well ID:		Well OD:	
Insertion Length:		Tip Diameter:	
Stem Length:		Tip Thickness:	
Root Diameter:		Head Length:	
LAG Length:	N/A	Immersion Length:	
Manufacturer:	WIKA		
Model:			

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Comm. Protocol:	N/A	Location:	N/A		
Smart:	No	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Temp Comp:	Yes	RTD Constant:	TBD		
Factory Calibration:	N/A				
T/C Burnout:	N/A				
Operating temp	N/A	Humidity:	N/A		
Calibrated Range:	N/A				
Body Material:	N/A				
SS Tag:	N/A				
Accuracy:	N/A				

ELEMENT

Tag Name:	TE-4233		
Type:	RTD	Probe Length:	
Single/Duplex:	Single	Fixed/Adjustable:	N/A
Range Limits:		Ice Pt Resistance:	
Sensor Length:		Temp Element	100 ohm Pt, α=0.00385
Probe Diameter:			
Sensor Material:			
No. of Lead Wire Terminations:	3	Lead Length:	144 in
Spring Loaded:	Yes	Grounded Junction:	N/A
Process Connection:			
Manufacturer:	WIKA		
Model:	AK		

CONNECTION HEAD

Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	7
Material:					
Style:					
Sensor connection:	RTD				
Conduit Connection:					
Termination Strip:	Three pole crastin				
Manufacturer:	WIKA				
Model:					

NOTES

Furnish with mounting accessories required for wall mount configuration

Thermowell model Resistance Temperature Detector (RTD) Model AK 0.5" Spring-loaded Bushing

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.

Contractor will fill in remaining fields with data from the selected instrument.

1.000 - Root Diameter based on flange size

0.625 - Tip Diameter

National Aeronautics and Space Administration
Ames Research Center

Temperature Instruments

Transmitters, Thermowells, RTDs, TCs

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
TE-4306			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: **SVS Boiler Replacement**

TAG NO:	**TE-4306**	Hookup Drawings:	J506/507	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		<-
Asset No:		P&ID:	J706	Line ID:		Size: -	Schedule: <-
Service Description:	Boiler FW Pump 1 Motor Temperature Element			Manufacturer:	WIKA		<-
				Model:	AK		<-
Safety class:	GS			Quality Assurance Level			<-

PROCESS CONDITIONS

Pressure:						Units	Fluid:	-	
Oper:	0	Design:	1	H2OTst:	-	psig	Area Classification:	N/A	
Temperature:							Ambient Temperature Requirements:	-	
Min:	By Vendor	Normal:	By Vendor	Max:	-	F	Service: BFW	Critical:	N/A
Flow:									
Min:	N/A	Normal:	N/A	Max:	N/A	gpm			

THERMOWELL

Tag Name:	TW-4306		
Type:		NACE:	N/A
Process Connection:			
Element Connection:			
Vibration Calculation:	N/A		
Max Pressure Rating:			
Material:			
Well ID:		Well OD:	
Insertion Length:		Tip Diameter:	
Stem Length:		Tip Thickness:	
Root Diameter:		Head Length:	
LAG Length:	N/A	Immersion Length:	
Manufacturer:	WIKA		
Model:			

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Comm. Protocol:	N/A	Location:	N/A		
Smart:	No	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Temp Comp:	Yes	RTD Constant:	TBD		
Factory Calibration:	N/A				
T/C Burnout:	N/A				
Operating temp	N/A	Humidity:	N/A		
Calibrated Range:	N/A				
Body Material:	N/A				
SS Tag:	N/A				
Accuracy:	N/A				

ELEMENT

Tag Name:	TE-4306		
Type:	RTD	Probe Length:	
Single/Duplex:	Single	Fixed/Adjustable:	N/A
Range Limits:		Ice Pt Resistance:	
Sensor Length:		Temp Element	100 ohm Pt, α=0.00385
Probe Diameter:			
Sensor Material:			
No. of Lead Wire Terminations:	3	Lead Length:	144 in
Spring Loaded:	Yes	Grounded Junction:	N/A
Process Connection:			
Manufacturer:	WIKA		
Model:	AK		

CONNECTION HEAD

Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	7
Material:					
Style:					
Sensor connection:	RTD				
Conduit Connection:					
Termination Strip:	Three pole crastin				
Manufacturer:	WIKA				
Model:					

NOTES

Furnish with mounting accessories required for wall mount configuration

Thermowell model Resistance Temperature Detector (RTD) Model AK 0.5" Spring-loaded Bushing

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.

Contractor will fill in remaining fields with data from the selected instrument.

1.000 - Root Diameter based on flange size

0.625 - Tip Diameter

National Aeronautics and Space Administration
Ames Research Center

Temperature Instruments

Transmitters, Thermowells, RTDs, TCs

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
TE-4336			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: **SVS Boiler Replacement**

TAG NO:	**TE-4336**	Hookup Drawings:	J506/507	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J706	Line ID:		Size: -	Schedule:
Service Description:	Boiler FW Pump 2 Motor Temperature Element			Manufacturer:	WIKA		
				Model:	AK		
Safety class:	GS			Quality Assurance Level			

PROCESS CONDITIONS

Pressure:						Units	Fluid:	-		
Oper:	0	Design:	1	H2OTst:	-	psig	Area Classification:	N/A		
Temperature:							Ambient Temperature Requirements:	-		
Min:	By Vendor	Normal:	By Vendor	Max:	-	F	Service:	BFW	Critical:	N/A
Flow:										
Min:	N/A	Normal:	N/A	Max:	N/A	gpm				

THERMOWELL

Tag Name:	TW-4336		
Type:		NACE:	N/A
Process Connection:			
Element Connection:			
Vibration Calculation:	N/A		
Max Pressure Rating:			
Material:			
Well ID:		Well OD:	
Insertion Length:		Tip Diameter:	
Stem Length:		Tip Thickness:	
Root Diameter:		Head Length:	
LAG Length:	N/A	Immersion Length:	
Manufacturer:	WIKA		
Model:			

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Comm. Protocol:	N/A	Location:	N/A		
Smart:	No	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Temp Comp:	Yes	RTD Constant:	TBD		
Factory Calibration:	N/A				
T/C Burnout:	N/A				
Operating temp	N/A	Humidity:	N/A		
Calibrated Range:	N/A				
Body Material:	N/A				
SS Tag:	N/A				
Accuracy:	N/A				

ELEMENT

Tag Name:	TE-4336		
Type:	RTD	Probe Length:	
Single/Duplex:	Single	Fixed/Adjustable:	N/A
Range Limits:		Ice Pt Resistance:	
Sensor Length:		Temp Element	100 ohm Pt, α=0.00385
Probe Diameter:			
Sensor Material:			
No. of Lead Wire Terminations:	3	Lead Length:	144 in
Spring Loaded:	Yes	Grounded Junction:	N/A
Process Connection:			
Manufacturer:	WIKA		
Model:	AK		

CONNECTION HEAD

Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	7
Material:					
Style:					
Sensor connection:	RTD				
Conduit Connection:					
Termination Strip:	Three pole crastin				
Manufacturer:	WIKA				
Model:					

NOTES

Furnish with mounting accessories required for wall mount configuration

Thermowell model Resistance Temperature Detector (RTD) Model AK 0.5" Spring-loaded Bushing

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.

Contractor will fill in remaining fields with data from the selected instrument.

1.000 - Root Diameter based on flange size

0.625 - Tip Diameter

National Aeronautics and Space Administration
Ames Research Center

Temperature Instruments

Transmitters, Thermowells, RTDs, TCs

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
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1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: SVS Boiler Replacement

TAG NO:	**TE-4366**	Hookup Drawings:	J506/507	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		<-
Asset No:		P&ID:	J706	Line ID:		Size: -	Schedule: <-
Service Description:	Boiler FW Pump 3 Motor Temperature Element			Manufacturer:	WIKA		<-
				Model:	AK		<-
Safety class:	GS			Quality Assurance Level			<-

PROCESS CONDITIONS

Pressure:						Units	Fluid:	-	<-
Oper:	0	Design:	1	H2OTst:	-	psig	Area Classification:	N/A	<-
Temperature:							Ambient Temperature Requirements:	-	<-
Min:	By Vendor	Normal:	By Vendor	Max:	-	F	Service: BFW	Critical: N/A	<-
Flow:									<-
Min:	N/A	Normal:	N/A	Max:	N/A	gpm			<-

THERMOWELL

Tag Name:	TW-4366		
Type:		NACE:	N/A
Process Connection:			
Element Connection:			
Vibration Calculation:	N/A		
Max Pressure Rating:			
Material:			
Well ID:		Well OD:	
Insertion Length:		Tip Diameter:	
Stem Length:		Tip Thickness:	
Root Diameter:		Head Length:	
LAG Length:	N/A	Immersion Length:	
Manufacturer:	WIKA		
Model:			

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Comm. Protocol:	N/A	Location:	N/A		
Smart:	No	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1:	N/A	IP2:	N/A
Temp Comp:	Yes	RTD Constant:	TBD		
Factory Calibration:	N/A				
T/C Burnout:	N/A				
Operating temp	N/A	Humidity:	N/A		
Calibrated Range:	N/A				
Body Material:	N/A				
SS Tag:	N/A				
Accuracy:	N/A				

ELEMENT

Tag Name:	TE-4366		
Type:	RTD	Probe Length:	
Single/Duplex:	Single	Fixed/Adjustable:	N/A
Range Limits:		Ice Pt Resistance:	
Sensor Length:		Temp Element	100 ohm Pt, α=0.00385
Probe Diameter:			
Sensor Material:			
No. of Lead Wire Terminations:	3	Lead Length:	144 in
Spring Loaded:	Yes	Grounded Junction:	N/A
Process Connection:			
Manufacturer:	WIKA		
Model:	AK		

CONNECTION HEAD

Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	7
Material:					
Style:					
Sensor connection:	RTD				
Conduit Connection:					
Termination Strip:	Three pole crastin				
Manufacturer:	WIKA				
Model:					

NOTES

Furnish with mounting accessories required for wall mount configuration

Thermowell model Resistance Temperature Detector (RTD) Model AK 0.5" Spring-loaded Bushing

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.

Contractor will fill in remaining fields with data from the selected instrument.

1.000 - Root Diameter based on flange size

0.625 - Tip Diameter

National Aeronautics and Space Administration
Ames Research Center

Temperature Instruments

Transmitters, Thermowells, RTDs, TCs

NO.	BY	DATE	REVISION

DATA SHEET NO.			REV.
TE-6621			0
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

Project: **SVS Boiler Replacement**

TAG NO:	**TE-6621**	Hookup Drawings:	J506/507	Loop Wiring Diagrams:		
		Spec No:	40 9500	Line / Vessel Number:	TK-6	<-
Asset No:		P&ID:	J715	Line ID:	Size: N/A Schedule:	<-
Service Description:	Ammonia Diffusion Tank Temperature Element			Manufacturer:	WIKA	<-
				Model:	AK	<-
Safety class:	GS			Quality Assurance Level		<-

PROCESS CONDITIONS

Pressure:						Units	Fluid:	NH3 in Water
Oper:	N/A	Design:	N/A	H2OTst:	N/A	psig	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	32 to 100 F
Min:	35	Normal:	100	Max:	160	F	Service: NH3 in Water	Critical: N/A
Flow:								
Min:	N/A	Normal:	N/A	Max:	N/A	gpm		

THERMOWELL

Tag Name:	TW-6621		
Type:		NACE:	N/A
Process Connection:			
Element Connection:			
Vibration Calculation:	N/A		
Max Pressure Rating:			
Material:			
Well ID:		Well OD:	
Insertion Length:		Tip Diameter:	
Stem Length:		Tip Thickness:	
Root Diameter:		Head Length:	
LAG Length:	N/A	Immersion Length:	
Manufacturer:	WIKA		
Model:			

TRANSMITTER

Voltage:	N/A				
Power Wiring:	N/A	Signal Type:	N/A		
Comm. Protocol:	N/A	Location:	N/A		
Smart:	No	Indicate:	N/A	Isolate:	N/A
Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	N/A	IP2:	N/A
Temp Comp:	Yes	RTD Constant:	TBD		
Factory Calibration:	N/A				
T/C Burnout:	N/A				
Operating temp	N/A	Humidity:	N/A		
Calibrated Range:	N/A				
Body Material:	N/A				
SS Tag:	N/A				
Accuracy:	N/A				

ELEMENT

Tag Name:	TE-6621		
Type:	RTD	Probe Length:	
Single/Duplex:	Single	Fixed/Adjustable:	N/A
Range Limits:		Ice Pt Resistance:	
Sensor Length:		Temp Element	100 ohm Pt, α=0.00385
Probe Diameter:			
Sensor Material:			
No. of Lead Wire Terminations:	3	Lead Length:	144 in
Spring Loaded:	Yes	Grounded Junction:	N/A
Process Connection:			
Manufacturer:	WIKA		
Model:	AK		

CONNECTION HEAD

Electrical Protection:	N/A	Temperature Category:	N/A		
Gas Group:	N/A	Enclosure Protection IP1	6	IP2:	7
Material:					
Style:					
Sensor connection:	RTD				
Conduit Connection:					
Termination Strip:	Three pole crastin				
Manufacturer:	WIKA				
Model:					

NOTES

Furnish with mounting accessories required for wall mount configuration

Thermowell model Resistance Temperature Detector (RTD) Model AK 0.5" Spring-loaded Bushing

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

1.000 - Root Diameter based on flange size
0.625 - Tip Diameter

National Aeronautics and Space Administration
Ames Research Center

Temperature Instruments
Bi-Metal Thermometer

DATA SHEET NO.			REV.
TI-4205			
SHEET	OF	DATE	
1	1	12-12-2012	
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NCC	AME		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project: **SVS Boiler Replacement**

TAG NO:	**TI-4205**	Hookup Drawings:	J506/507	Loop Wiring Diagrams:					
		Spec No:	40 9500	Line / Vessel Number:	N/A				<-
Asset No:		P&ID:	J702	Line ID:	N/A	Size:	-	Schedule:	N/A <-
Service Description:	Deaerator Tank Local Temperature Indicator			Manufacturer:	WIKA				<-
				Model:	52				<-
Safety class:	GS			Quality Assurance Level	N/A				<-

PROCESS CONDITIONS

Pressure:						Units	Fluid:	Water
Min:	0	Normal:	N/A	Max:	30	psig	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	275
Low:	0	High:	250	Max:	250	F	Service: BFW	Critical: N/A
Flow:								
Min:	N/A	Normal:	N/A	Max:	N/A	N/A		

GAUGE

Type:		Probe Length:	
Range Limits:		Single/Dual Scale:	
Probe Diameter:			
Sensor Material:			
Process Connection:			

NOTES

Furnish with thermowell

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Temperature Instruments
Bi-Metal Thermometer

DATA SHEET NO.	REV.
TI-4232	

SHEET	OF	DATE
1	1	12-12-2012

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

NO.	BY	DATE	REVISION

Project: **SVS Boiler Replacement**

TAG NO:	**TI-4232**	Hookup Drawings:	J506/507	Loop Wiring Diagrams:				
		Spec No:	40 9500	Line / Vessel Number:	N/A			
Asset No:		P&ID:	J702	Line ID:	N/A	Size:	-	Schedule: N/A
Service Description:	Feedwater Tank Local Temperature Indicator			Manufacturer:	WIKA			
				Model:	52			
Safety class:	GS			Quality Assurance Level	N/A			

PROCESS CONDITIONS

Pressure:						Units	Fluid:	Water
Min:	0	Normal:	N/A	Max:	30	psig	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	275
Low:	0	High:	250	Max:	250	F	Service: BFW	Critical: N/A
Flow:								
Min:	N/A	Normal:	N/A	Max:	N/A	N/A		

GAUGE

Type:		Probe Length:	
Range Limits:		Single/Dual Scale:	
Probe Diameter:			
Sensor Material:			
Process Connection:			

NOTES

Furnish with thermowell

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Temperature Instruments
Bi-Metal Thermometer

DATA SHEET NO.			REV.
TI-5629			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project: SVS Boiler Replacement

TAG NO:	**TI-5629**	Hookup Drawings:	J506/507	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	N/A		
Asset No:		P&ID:	J702	Line ID:	N/A	Size: N/A	Schedule: N/A
Service Description:	Auxiliary Steam Boiler Local Temperature Indicator			Manufacturer:	WIKA		
				Model:	52		
Safety class:	GS			Quality Assurance Level	N/A		

PROCESS CONDITIONS

Pressure:						Units	Fluid:	Water
Min:	0	Normal:	N/A	Max:	Notes	psig	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	Notes
Low:	0	High:	Notes	Max:	Notes	F	Service: CBD	Critical: N/A
Flow:								
Min:	N/A	Normal:	N/A	Max:	N/A	N/A		

GAUGE

Type:		Probe Length:	
Range Limits:		Single/Dual Scale:	
Probe Diameter:			
Sensor Material:			
Process Connection:			

NOTES

Furnish with thermowell

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects. Contractor will refer to selected Auxiliary Boiler and fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Temperature Instruments
Bi-Metal Thermometer

DATA SHEET NO.	REV.
TI-5715	

SHEET	OF	DATE
1	1	12-12-2012

BY	CHK'D	PROC.	APPR.
NCC	AME		

P.O.	
REQ.	

NO.	BY	DATE	REVISION

Project: SVS Boiler Replacement

TAG NO:	**TI-5715**	Hookup Drawings:	J506/507	Loop Wiring Diagrams:				
		Spec No:	40 9500	Line / Vessel Number:	N/A			
Asset No:		P&ID:	J704	Line ID:	N/A	Size:	2	Schedule: N/A
Service Description:	Continuous Blowdown Tank Outlet Local Temperature Indicator			Manufacturer:	WIKA			
				Model:	52			
Safety class:	GS			Quality Assurance Level	N/A			

PROCESS CONDITIONS

Pressure:						Units
Min:	0	Normal:	N/A	Max:	150	psig
Temperature:						
Low:	0	High:	400	Max:	400	F
Flow:						
Min:	N/A	Normal:	N/A	Max:	N/A	N/A

Fluid:	Water		
Area Classification:	N/A		
Ambient Temperature Requirements:	350		
Service:	CBD	Critical:	N/A

GAUGE

Type:		Probe Length:	
Range Limits:		Single/Dual Scale:	
Probe Diameter:			
Sensor Material:			
Process Connection:			

NOTES

Furnish with thermowell

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects. Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Temperature Instruments
Bi-Metal Thermometer

DATA SHEET NO.			REV.
TI-5731			
SHEET	OF	DATE	
1	1	12-12-2012	
BY	CHK'D	PROC.	APPR.
NCC	AME		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project: **SVS Boiler Replacement**

TAG NO:	**TI-5731**	Hookup Drawings:	J506/507	Loop Wiring Diagrams:					<-
		Spec No:	40 9500	Line / Vessel Number:	N/A				<-
Asset No:		P&ID:	J705	Line ID:	N/A	Size:	-	Schedule: N/A	<-
Service Description:	Intermittent Blowdown Tank Local Temperature			Manufacturer:	WIKA				<-
				Model:	52				<-
Safety class:	GS			Quality Assurance Level	N/A				<-

PROCESS CONDITIONS

Pressure:						Units	Fluid:	Water	
Min:	0	Normal:	N/A	Max:	1	psig	Area Classification:	N/A	
Temperature:							Ambient Temperature Requirements:	100	
Low:	0	High:	120	Max:	120	F	Service: IBD	Critical:	N/A
Flow:									
Min:	N/A	Normal:	N/A	Max:	N/A	N/A			

GAUGE

Type:		Probe Length:	
Range Limits:		Single/Dual Scale:	
Probe Diameter:			
Sensor Material:			
Process Connection:			

NOTES

Furnish with thermowell

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects.
Contractor will fill in remaining fields with data from the selected instrument.

National Aeronautics and Space Administration
Ames Research Center

Temperature Instruments
Bi-Metal Thermometer

DATA SHEET NO.			REV.
TI-6620			
SHEET	OF	DATE	
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NCC	AME		
P.O.			
REQ.			

NO.	BY	DATE	REVISION

Project: SVS Boiler Replacement

TAG NO:	**TI-6620**	Hookup Drawings:	J506/507	Loop Wiring Diagrams:			
		Spec No:	40 9500	Line / Vessel Number:	TK-6		<-
Asset No:		P&ID:	J715	Line ID: N/A	Size: N/A	Schedule: N/A	<-
Service Description:	Ammonia Diffusion Tank Local Temperature Indication			Manufacturer:	WIKA		<-
				Model:	52		<-
Safety class:	GS			Quality Assurance Level	N/A		<-

PROCESS CONDITIONS

Pressure:						Units	Fluid:	NH3 in Water
Min:	0	Normal:	N/A	Max:	N/A	psig	Area Classification:	N/A
Temperature:							Ambient Temperature Requirements:	32 to 100 F
Low:	35	High:	100	Max:	160	F	Service: NH3	Critical: N/A
Flow:								
Min:	N/A	Normal:	N/A	Max:	N/A	N/A		

GAUGE

Type:		Probe Length:	
Range Limits:		Single/Dual Scale:	
Probe Diameter:			
Sensor Material:			
Process Connection:			

NOTES

Furnish with thermowell

Manufacturer listing is for reference. Contractor will select an appropriate instruments to provide a complete system that is functional in all respects. Contractor will fill in remaining fields with data from the selected instrument.

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-- End of Section Table of Contents --

SECTION 43 21 13

PUMPS: WATER, CENTRIFUGAL

PART 1 GENERAL

1.1 SUMMARY

This section covers centrifugal pumps - electric motor and internal combustion engine operated.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN PETROLEUM INSTITUTE (API)

API 610	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries

ASME INTERNATIONAL (ASME)

ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B40.100	Pressure Gauges and Gauge Attachments

ASSOCIATION FOR IRON AND STEEL TECHNOLOGY (AIST)

AIST PB-229	Stainless Steels: A Steel Products Manual

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.2	Rotodynamic (Centrifugal) Pump for Nomenclature and Definition

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 21	White or Colored Silicone Alkyd Paint (Type I, High Gloss and Type II, Medium Gloss)
SSPC Paint 25	Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

1.3 SYSTEM DESCRIPTION

1.3.1 Selection Criteria

Design pumps using hydraulic criteria based upon actual model developmental test data. Select pumps at a point within the maximum efficiency for a given impeller casing combination. Deviations within 3 percent of maximum efficiency are permissible, provided the lesser efficiency is not less than the scheduled efficiency. Pumps having impeller diameters larger than 90 percent of the published maximum diameter of the casing or less than 15 percent larger than the published minimum diameter of the casing will be rejected. Acceptable maximum impeller diameter calculations shall not be based on percentage of impeller diameter range for a given casing.

1.3.2 Conformance With Agency Requirements

Where materials or equipment are specified to be an approved type, the seal or label of approval from a nationally recognized testing agency, adequately equipped and competent to perform such services, shall be attached thereto. A written certificate from the testing agency shall accompany the materials or equipment and shall be submitted to the COR stating that the items have been tested and that they conform to the applicable requirements of the specifications and to the standards listed herein. The certificate shall indicate the methods of testing used by the testing agency. In lieu of a certificate from a testing agency, published catalog specification data, accompanied by the manufacturer's certified statement to the effect that the items are in accordance with the applicable requirements of the specifications and the referenced standards, will be considered by the COR and may be acceptable as evidence that the items conform with agency requirements.

1.3.3 Safety Requirements

Fully enclose or properly guard gears, couplings, projecting set-screws, keys, and other rotating parts, so located that any person can come in close proximity thereto.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

Drawings containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Show on the Drawings proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation. Provide a complete listing of equipment and materials.

SD-03 Product Data

Materials and Equipment

Manufacturer's descriptive data and technical literature, performance charts and curves for all impeller sizes for a given casing, catalog cuts, and installation instructions. Spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than two months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Instructions

Proposed diagrams, instructions, and other sheets, prior to posting. Approved wiring and control diagrams showing the complete layout of the entire system, including equipment, piping valves, and control sequence, framed under glass or in approved laminated plastic, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams, and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

Training Period

Training course curriculum and training instructions shall be furnished to the COR 14 days prior to the start of training.

SD-06 Test Reports

Field Tests

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-07 Certificates

Manufacturer's Representative

The names and qualifications of the manufacturer's representative and training engineers and written certification from the manufacturer that the representative and trainers are technically qualified.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

Six complete sets of instructions containing the manufacturer's operating and maintenance instructions for each piece of equipment. One complete set at the time the tests procedure is submitted; remaining sets before the contract is completed. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS," name and location of the building, name of the Contractor, and contract number. Flysheets shall be placed before instructions covering each subject. Instruction sheets shall be approximately 8-1/2 by 11 inches, with large sheets of drawings folded in. Instructions shall include, but not be limited to, the following:

a. System layout showing piping, valves, and controls.

b. Approved wiring and control diagrams.

c. A control sequence describing startup, operation, and shutdown.

d. Operating and maintenance instructions for each piece of equipment, including lubrication instructions and troubleshooting guide.

e. Manufacturer's bulletins, cuts, and descriptive data; and parts list and recommended spare parts.

1.5 QUALITY ASSURANCE

Provide the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment specified. The representative shall supervise the installation, adjustment, and testing of the equipment. Up to five days service shall be provided at no expense to the Government.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect all equipment, delivered and designated for storage, from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are as specified below, as shown, and are suitable for the service intended. Provide materials and equipment which are new and unused, except for tests. Where two or more pieces of equipment performing the same function are required, they shall be duplicate products of the same manufacturer.

2.1.1 Standard Products

Provide material and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate equipment that has been in satisfactory waterworks operation at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the COR, reasonably convenient to the jobsite. Pumps and motors of the same types shall each be the product of one manufacturer.

2.1.2 Description

The pumps shall be horizontal centrifugal water pumps of the types indicated and specified. The single driving units for the pumps shall be electric motors as indicated and specified.

2.1.3 Nameplates

Pumps and motors shall have a standard nameplate securely affixed in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, the nameplate for each pump shall show the capacity in gpm at rated speed in rpm and head in feet of water. Nameplate for each electric motor shall show at least the minimum information required by 10.38 NEMA MG 1. Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

2.2 CENTRIFUGAL WATER PUMPS

The pumps shall be the centrifugal, single-stage or multi-stage type, designed for water service as scheduled.

2.2.1 Pump Service

The pumps shall be utilized for service scheduled.:

2.2.2 Pump Drives

The pumps shall have electric motor driving units and shall be directly connected to the driving units through solid shafts or flexible couplings (as appropriate). Provide variable speed drive where scheduled.

2.2.3 Pump Construction

Except as below specified, centrifugal water pumps shall be constructed in accordance with the Hydraulic Institute HI 1.1-1.2 and API 610.

2.2.4 Pump Characteristics

The pumps shall be capable of discharging quantities at total discharge heads measured at the discharge flange as scheduled.

Pumps shall operate at optimum efficiencies to produce the most economical pumping system under the conditions encountered Pumps shall furnish not less than 150 percent of rated capacity at a total discharge head of not less than 65 percent of total rated head. The shutoff total head shall be not greater than 120 percent of total rated head.

2.2.5 Pump Casings

Pump casings shall be cast iron or steel.

The casings shall be designed to permit replacement of wearing parts. Pump casings shall be of uniform quality and free from blowholes, porosity, hard spots, shrinkage defects, cracks and other injurious defects. Defects in casings shall not be repaired except when such work is approved and is done by or under the supervision of the pump manufacturer, and then only when the defects are small and do not adversely affect the strength or use of the casing. Casings shall be single or double volute with flanged piping connections conforming to ASME B16.5. Flange connections shall mate with flange Class specified for connecting pipe system. The direction of shaft rotation shall be conspicuously indicated. The casing shall have tapped openings for air venting, priming, draining, and suction and discharge gauges. A brass or bronze umbrella or vent cock shall be furnished for venting except where automatic air vents are indicated. Drain openings in the volute, intake, or other passages capable of retaining trapped water shall be located in the low point of such passages.

2.2.6 Impellers

Impellers shall be of enclosed design and shall be constructed of bronze, carefully finished with smooth water passageways, and shall be statically and dynamically balanced. Impellers shall be securely keyed to the pump shaft. Impellers on vertical-split pumps shall be additionally secured with a self-locking nut.

2.2.7 Wearing Rings

Wearing rings of bronze shall be provided for impellers. Wearing rings of a different composition or of a suitable ferrous material shall be provided for pump casings. Casing rings shall be securely fixed in position to prevent rotation. Rings shall be renewable and designed to ensure ease of maintenance.

2.2.8 Shaft

Shaft shall be of high grade steel, accurately machined, and shall be of sufficient size and strength to perform the work required. Bronze renewable shaft sleeves shall be provided for protection of the shaft in contact with water, and in the stuffing boxes. Shaft sleeves shall be keyed to the pump shaft.

2.2.9 Mechanical Seals

Mechanical seals shall be balanced or unbalanced, as necessary to conform to specified service requirements. Mechanical seals shall be constructed

in a manner and of materials particularly suitable for the temperature service range and quality of water being pumped. Seal construction shall not require external source cooling for pumped-fluid service temperatures up to 250 degrees F. Seal pressure rating shall be suitable for maximum system hydraulic conditions. Materials of construction shall include AIST PB-229 series stainless steel, solid tungsten-carbide rotating-seal face, and Buna-N vinylidene-fluoride-hexafluoropropylene, EPT, or tetrafluoroethylene seals. Bypass flushing water supply shall be free of iron rust products and other abrasive materials and shall be directed onto face of seal without dead ending. All piping and accessories shall be provided. Throttling bushing shall have clearances to minimize leakage in case of complete seal failure without restriction of flushing water. Mechanical seals shall not be subjected to hydrostatic test pressures in excess of the manufacturer's recommendations.

2.2.10 Couplings

Couplings shall be of the heavy-duty flexible type, keyed and locked to the shaft. The outside surface of the couplings for horizontal pumps and close-coupled vertical pumps shall be machined parallel to the axis of the shaft. The faces of the couplings shall be machined perpendicular to the axis of the shaft. Disconnecting the couplings shall be accomplished without removing the driver half or the pump half of the couplings from the shaft. Couplings for vertical pumps other than close-coupled vertical pumps may be of the universal type. Flexible couplings shall not be used to compensate for misalignment of pump.

2.2.11 Balance

All rotating parts of the equipment shall operate throughout the required range without excessive end thrust, vibration, or noise. Defects of this type that cannot be eliminated by installation adjustments will be sufficient cause for rejection of the equipment. Pump impeller assemblies shall be statically and dynamically balanced to within 1/2 percent of W times R squared, where W equals weight and R equals impeller radius. Shaft construction shall be substantial to prevent seal or bearing failure due to vibration. Total shaft peak-to-peak dynamic deflection measured by vibrometer at pump-seal face shall not exceed 2.0 mils under shutoff-head operating conditions. Flow from 1/4 inch iron pipe size (ips) pipe shall be provided during testing.

2.2.12 Bearings

Bearings shall be ball or roller type, and the main bearings shall take all radial and end thrust. Pumps that depend only on hydraulic balance to overcome end thrust will not be acceptable.

2.2.13 Lubrication

Bearings on horizontal-shaft pumps shall be either oil-bath type or grease type. Each oil reservoir shall be liberal in size and provided with an opening for filling, an overflow opening at the proper location to prevent overfilling, an oil-level sight glass, and a drain at the lowest point. Grease type bearings shall be provided with fittings for a grease gun and, if the bearings are not easily accessible, with grease tubing extending to convenient locations. The grease fittings shall be of a type that prevent over lubrication and the buildup of pressure injurious to the bearings.

2.2.14 Base Plates

Horizontal-shaft centrifugal pumps shall be provided with a common base for mounting each pump and driving unit of the pump on the same base. Each base shall be constructed of cast iron with a raised lip tapped for drainage, or of welded steel shapes with suitable drainage pan. Horizontal-shaft end suction pumps shall be mounted on a factory furnished channel steel frame. With the exception of close-coupled pumps, horizontal-shaft end suction pumps shall be frame mounted. The drainage structure shall have a 1/2 inch NPT connection to connect it to a drain.

2.2.15 Cocks, Plugs, and Accessories

The pumps shall be equipped with air cocks, drain plugs, and duplex gauges indicating discharge pressures for all pumps and suction pressures for pumps without suction lift. Gauges, equipped with a shutoff cock and snubber, shall conform to ASME B40.100, and shall be calibrated in psi and feet of water in not more than 2 psi increments. Gauge ranges shall be appropriate for the particular installation. Normal operating suction and discharge pressures of the pump shall be indicated on the mid-point range of the gauges. Pressure relief valve shall be furnished and installed where indicated.

2.2.16 Piping Connections

The pump suction and discharge shall be provided with flanged connections of suitable size and suitably arranged for piping shown. Pipe flanges shall conform to ASME B16.5. Piping shall be installed to preclude the formation of air pockets. Construct flange nozzle for allowable loads to meet or exceed ANSI/HI 9.6.2.

2.2.17 Finish

Pump shall have painted or enameled finish as is standard with the manufacturer.

2.3 ELECTRICAL WORK

Electrical motor driven equipment specified herein shall be provided complete with motors, motor starters, and controls. Electric equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical characteristics shall be as indicated. Motor starters shall be provided complete with properly sized thermal overload protection in each phase and other appurtenances necessary for the motor control specified. Each motor shall be of sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor when operating at proper electrical system voltage and frequency. Manual or automatic control and protective or signal devices required for the operation herein specified and any control wiring required for controls and devices but not shown on electrical plans shall be provided under this section of the specifications.

2.4 ELECTRICAL EQUIPMENT

Motor controls, equipment, and wiring shall be in accordance with NFPA 70.

2.4.1 Electric Motors

Each electric motor-driven pump shall be driven by a totally-enclosed fan

cooled continuous-duty electric motor. Motor shall have a 1.25 service factor. Motors shall be squirrel-cage induction motors having normal-starting-torque and low-starting-current characteristics, and shall be of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1. Motor bearings shall provide smooth operations under the conditions encountered for the life of the motor. Adequate thrust bearing shall be provided in the motor to carry the weight of all rotating parts plus the hydraulic thrust and shall be capable of withstanding upthrust imposed during pump starting and under variable pumping head conditions specified. Motors shall be rated as scheduled, and such rating shall be stamped on the nameplate. Motorsshall conform to NEMA MG 1.

2.4.2 Control Equipment

Automatically controlled pumps shall have three-position "MANUAL-OFF-AUTOMATIC" selector switch in cover. Additional controls or protective devices shall be as indicated.

2.4.3 Variable Speed Controls

The variable speed motor controller shall convert 460 volt plus 15 percent, minus 5 percent, three phase, 60 Hz (plus or minus 2 Hz) utility power to adjustable voltage/frequency, three phase, ac power for stepless motor control from 5 percent to 105 percent of base speed.

2.4.3.1 Description

The variable speed drive shall produce an adjustable ac voltage/frequency output for complete motor speed control. The variable speed drive shall be automatically controlled by a grounded electronic control signal. The variable speed drive shall be self contained, totally enclosed in a NEMA MG 1 ventilated cabinet and capable of operation between 32 and 104 degrees F. The variable speed drive maximum output current rating shall be equal to or exceed the motor nameplate full load. The manufacturer shall advise the maximum recommended motor sine wave current for each controller rating. Variable speed drive shall be 95 percent efficient at 100 percent rated output power, 60 Hz.

2.4.3.2 Governing Requirements

Variable speed drives shall conform to the following requirements:

a. Variable speed drive shall comply with 47 CFR 15 regulation of RF1/EM1 emission limits for Class A computing devices. The FCC label of compliance shall be displayed on the variable speed drive.

b. The variable speed drive and options shall comply with the applicable requirements and the standards of the American National Standards Institute (ANSI).

c. Variable speed drive and option design and construction thereof shall comply with all applicable provisions of NFPA 70, Article 43D, Sections A-L.

2.4.3.3 Quality Assurance

To ensure quality the variable speed drive shall be subject to the

following tests:

a. The integrated circuits shall undergo a 160-hour "burn-in" to test reliability. During the "burn-in" the temperature shall be cycled between 32 and 158 degrees F.

b. The completed unit shall undergo a fully loaded 24-hour "burn-in."

c. The unit shall be subject to a series of in-plant quality controlled inspections before approval for shipment from manufacturer's facilities.

2.4.3.4 Service

The variable speed drive shall be supplied with the following:

a. One-year parts and labor warranty.

b. A troubleshooting guide to help the building operator determine what steps must be taken to correct any problem that may exist in the system.

2.4.3.5 Basic Features

The variable speed drive shall have the following basic features:

a. Hand/Off/Auto Operation.

b. Manual/Auto speed reference switch.

c. Minimum/maximum adjustable speeds.

d. Speed potentiometer.

e. Auto restart.

f. Linear timed acceleration and deceleration for soft starting/stopping.

g. 3-63 Hz controlled speed range. (Factory set at 15 Hz minimum).

h. Terminal connections for time clock control, fire, smoke, freeze detectors, and EP relay pre-set speed override.

i. Output frequency terminals for remote metering.

2.4.3.6 Protective Circuits and Features

The variable speed drive controller shall include the following protective circuits/features:

a. Current limits to 100 percent design by slowing down motor.

b. Instantaneous Electronic Trip - automatically shutdown motor if current exceed 120 percent of design or phase-to-phase output short circuit occurs.

c. The variable speed drive will restart automatically when input line returns to normal in the event of intermittent power outage or phase loss or overvoltage shutdown.

d. Input power protection shuts down the unit if the following faults

occur; low input line voltage or loss of an input phase.

e. Insensitive to incoming power phase.

f. Fast acting current limiting input fuses, (Class J) rated with 200,000 interrupting amperes capability.

g. Isolated 115 volt control circuit and dedicated control transformer.

h. Line-to-line fault protection.

i. Line-to-ground short circuiting and accidental motor grounding protection.

j. Output thermal overload relay trip.

2.4.3.7 Adjustments

The variable speed drive has the following adjustments available via potentiometers located on the faceplate of a single, regulator printed circuit board.

a. Minimum speed: 0-75 percent.

b. Maximum speed: 50-100 percent.

2.5 EQUIPMENT APPURTENANCES

2.5.1 Attachments

All necessary bolts, nuts, washers, bolt sleeves, and other types of attachments for the installation of the equipment shall be furnished with the equipment. Bolts shall conform to the requirements of ASTM A307 and nuts shall be hexagonal of the same quality as the bolts used. Threads shall be clean-cut and shall conform to ASME B1.1. Bolts, nuts, and washers specified to be galvanized or not otherwise indicated or specified, shall be zinc coated after being threaded, by the hot-dip process conforming to ASTM A123/A123M or ASTM A153/A153M as appropriate. Bolts, nuts, and washers specified or indicated to be stainless steel shall be Type 316.

2.5.2 Equipment Guards

Equipment driven by open shafts, belts, chains, or gears shall be provided with all-metal guards enclosing the drive mechanism. Guard shall be constructed of galvanized sheet steel or galvanized woven wire or expanded metal set in a frame of galvanized steel members. Guards shall be secured in position by steel braces or straps which will permit easy removal for servicing the equipment. The guards shall conform in all respects to all applicable safety codes and regulations.

2.5.3 Tools

A complete set of all special tools which may be necessary for the adjustment, operation, maintenance, and disassembly of all equipment shall be furnished. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment. Special tools shall be high-grade, smooth, forged, alloy, tool steel. One pressure grease gun for each type of grease

required shall also be furnished. All tools shall be delivered at the same time as the equipment to which they pertain. Properly store and safeguard such tools until completion of the work, at which time they shall be delivered to the COR.

2.5.4 Shop Painting

All motors, pump casings, and similar parts of equipment customarily finished in the shop shall be thoroughly cleaned, primed, and given two finish coats of paint at the factory in accordance with the recommendations of the manufacturer. Ferrous surfaces not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating.

2.6 FACTORY TESTS

Pumps shall be tested by the manufacturer or a nationally recognized testing agency in compliance with Hydraulic Institute Standards. Where two or more identical pumps are specified, only one representative pump shall be tested. Certified test results shall be submitted to the COR.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field and advise the COR of any discrepancy before performing the work.

3.2 INSTALLATION

Install each pump in accordance with the written instructions of the manufacturer and under the direct supervision of the manufacturer's representative. Concrete for equipment foundations shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Concrete foundations shall be integral with and of the same class as that of the building floor unless otherwise indicated. Foundation bolts, as required, shall be furnished for proper positioning during the placement of the concrete.

3.3 FIELD TESTS

After installation of the pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. Make arrangements to have the manufacturer's representatives present when field equipment tests are made. Each pumping unit shall be given a running field test in the presence of the COR for a minimum of 2 hours. Each pumping unit shall be operated at its rated capacity or such other point on its head-capacity curve selected by the COR. Provide an accurate and acceptable method of measuring the discharge flow. Tests shall assure that the units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted.

3.4 FIELD PAINTING

Do not paint stainless steel, galvanized steel, and nonferrous surfaces.

3.4.1 Touch-Up Painting

Factory painted items requiring touching up in the field shall be thoroughly cleaned of all foreign material and shall be primed and topcoated with the manufacturer's standard factory finish.

3.4.2 Exposed Ferrous Surfaces

Exposed ferrous surfaces shall be painted with two coats of enamel paint conforming to SSPC Paint 21. Factory primed surfaces shall be solvent-cleaned before painting. Surfaces that have not been factory primed shall be prepared and primed with one coat of SSPC Paint 25 or in accordance with the enamel paint manufacturer's recommendations.

3.5 DEMONSTRATION

Upon completion of the work, and at a time designated by the COR, the services of one or more competent engineers shall be provided for a training period of not less than 8 hours to instruct a representative of the Government in the contents of the operation and maintenance manuals for the equipment furnished under these specifications. These field instructions shall cover all the items contained in the bound instructions.

-- End of Section --

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SECTION 44 10 00

AIR POLLUTION CONTROL

PART 1 GENERAL

1.1 SUMMARY

This section covers air pollution control equipment and accessories for use with various pollutant emitters.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C700	Standard for Cold Water Meters - Displacement Type, Bronze Main Case

ASME INTERNATIONAL (ASME)

ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ASME B16.1	Gray Iron Threaded Fittings; Classes 25, 125 and 250
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.15	Cast Bronze Alloy Threaded Fittings Classes 125 and 250
ASME B16.24	Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500
ASME B16.3	Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.39	Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	Standard for Factory-Made Wrought Steel Buttwelding Fittings

ASME B31.1	Power Piping
ASME B40.100	Pressure Gauges and Gauge Attachments
ASME PTC 19.3	Temperature Measurement
ASME PTC 38	Determining the Concentration of Particulate Matter in a Gas Stream

ASTM INTERNATIONAL (ASTM)

ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A733	Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A924/A924M	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 280	Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 42	Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B 68	Standard Specification for Seamless Copper Tube, Bright Annealed
ASTM B 88	Standard Specification for Seamless Copper Water Tube
ASTM D 1248	Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM F 1139	Steam Traps and Drains

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-70	Gray Iron Gate Valves, Flanged and

	Threaded Ends
MSS SP-80	Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	Standard for Industrial Control and Systems: General Requirements
NEMA ICS 6	Enclosures
NEMA MG 1	Motors and Generators

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	Seismic Design for Buildings

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
40 CFR 50	National Primary and Secondary Ambient Air Quality Standards
40 CFR 60	Standards of Performance for New Stationary Sources

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings

Detail drawings containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-03 Product Data

Emission Monitoring System

Reports for emissions permit compliance.

Air Pollution Control Equipment

a. A complete list of equipment and material, including manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions. Spare parts data for each different item of material and equipment specified, after approval of detail drawings and not later than 1 month prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

b. Proposed diagrams, instructions, and other sheets, prior to posting. Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, including equipment, piping, valves, and control sequence, shall be posted where directed. Condensed operating instructions explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams, and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the system.

Instrumentation and Controls

Detailed manufacturer's data on the overall controls, sensors, process controllers, control operators, ladder diagrams, timers, sequence of controls, valves, alarms, signals, interlocks and cut off systems. Data describing in detail the equipment used to monitor emissions, including the sampling probe, filters, sampling pump, moisture separator/drier, tubing, analyzer, analyzer calibration system, data recorder, and alarms. Process and instrumentation diagrams (P&IDs).

Training

Training course curriculum and training instructions 14 days prior to the start of training.

Testing and Inspections

A proposed performance test procedure, 30 days prior to the proposed test date, containing a complete description of the proposed tests and sample locations, with calibration curves or test results by an independent testing laboratory of each instrument, meter, and gauge to be used in the tests. The test shall not commence until the procedure has been approved.

SD-06 Test Reports

Factory Tests

Printout of factory test results.

Testing and Inspections

Test procedures, prior to starting test. Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to provide compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-07 Certificates

Manufacturer's Field Representative

Names and qualifications of each manufacturer's field

representative and training engineer with written certification from the manufacturer that each representative and trainer is technically qualified.

SD-10 Operation and Maintenance Data

Air Pollution Control Equipment, Data Package 4
Accessories, Data Package 4

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALIFICATIONS

1.4.1 Welding

Structural members shall be welded in accordance with Section 05 12 00 STRUCTURAL STEEL. Welding and nondestructive testing procedures are specified in Section 40 17 26.00 20 WELDING PRESSURE PIPING.

1.4.2 Contractor

Contractor shall have had a minimum of 5 years of experience in the construction and maintenance of industrial air pollution control systems.

1.4.3 Manufacturer's Field Representative

Services of a manufacturer's field representative, who is experienced in the installation, adjustment, and operation of the equipment furnished, and who has complete knowledge of the proper operation and maintenance of the system, shall be provided. Field representative shall be onsite to supervise the installation, adjustment and compliance testing of the equipment. Field representative shall provide supervision of the system for 20 days after startup of the system.

1.5 CONSTRUCTION REQUIREMENTS

System shall be suitable for outdoor installation and shall be provided with a weather enclosure. Seismic protection of equipment shall be in accordance with UFC 3-310-04, Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT, Section 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT, and Section 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

1.6 DELIVERY, STORAGE, AND HANDLING

Store all equipment delivered and placed in storage as recommended by the manufacturer, with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

1.7 EXTRA MATERIALS

Auxiliaries for maintenance shall be provided with the equipment and shall include all special tools, rigs, jigs, fixtures, equipment, or other devices required for normal operation and service. Any equipment required for routine maintenance such as filter wash facilities, oil or refrigerant removal, and replacement devices shall be provided. Tests or measurement instruments or gauges shall be included. The following shall also be furnished:

a. Spare parts for each different item of material and equipment specified including all the of parts recommended by the manufacturer to be replaced after 1 year and 3 years service.

b. One set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening. Equipment shall be supported by in-service organization that is, in the opinion of the COR, reasonably convenient to the site. In-service organization shall respond to a service call within 24 hours.

2.1.2 General Requirements

Equipment and appurtenances shall be as specified and as shown on the approved detail drawings, and shall be suitable for the service intended. Materials and equipment shall be new and unused, to include testing equipment furnished under the contract. Components that serve the same function and are the same size shall be identical products of the same manufacturer.

2.1.3 Nameplates

Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment. Each piece of equipment shall bear the approval designation and the markings required for that designation. Valves shall be marked in accordance with MSS SP-25 and shall bear a securely attached tag with the manufacturer's name, catalog number and valve identification permanently displayed.

2.1.4 Equipment Guards and Access

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto, shall be enclosed or guarded to prevent accidental personal injury, in accordance with 29 CFR 1910, Subpart O, Machinery and Machine Guarding. Guards shall be removable and arranged to allow access to the equipment for maintenance. High-temperature equipment and piping so located as to endanger personnel or to create a fire hazard shall be guarded or covered with insulation of type specified for service. Items such as catwalk, stair, ladder, and guardrail shall be provided where shown and shall be in accordance with Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS or 05 51 33 METAL LADDERS.

2.2 GAUGE

Gauge shall conform to the following:

2.2.1 Draft Gauge

ASME B40.100. Tubing for gauges for service above 150 degrees F shall conform to ASTM B 68; for service below 150 degrees F, plastic tubing conforming to ASTM D 1248 may be used.

2.2.2 Gauges, Pressure and Vacuum

ASME B40.100, range suitable for the related conditions.

2.3 PIPE, FITTINGS, AND TUBING

Pipe, fittings, and tubing shall conform to the following:

2.3.1 Pipe

ASTM A53/A53M, Type S, Grade A, standard weight; or copper pipe, ASTM B 42.

2.3.2 Nipples

ASTM A733, standard weight to match adjacent piping.

2.3.3 Pipe Fittings

2.3.3.1 Steel Pipe Fittings

ASME B16.9 for butt-welding fittings; ASME B16.11 for socket-welding fittings; and ASME B16.5 for flanged fittings.

2.3.3.2 Brass or Bronze Pipe Fittings

ASME B16.15, Class A, 125 pound.

2.3.3.3 Malleable-Iron Pipe Fittings

ASME B16.3, type to match adjacent piping.

2.3.3.4 Unions

ASME B16.39, type to match adjacent piping.

2.3.3.5 Flanges, Cast-Iron and Bronze

ASME B16.1 and ASME B16.24.

2.3.3.6 Pipe Threads

ASME B1.20.1.

2.3.4 Tube, Copper

2.3.4.1 Tube for Air, Water, Gas, and Drains

ASTM B 68 or ASTM B 88.

2.3.4.2 Tube for Refrigeration Systems

ASTM B 280.

2.4 STEEL SHEET

Steel sheets shall conform to the following:

2.4.1 Zinc Coated (Galvanized)

ASTM A653/A653M;ASTM A924/A924M for dust collector casings, housing, and components. Gauges specified are manufacturers' standard gauge.

2.4.2 Low-Carbon

Gauges specified, for dust collector casings, housings, and components, refer to manufacturers' standard gauge.

2.4.3 Corrosion Resistant

ASTM A167, Class 304 or 316. Gauges specified refer to U.S. Standard Gauge.

2.5 AIR TRAPS

Air traps for removal of moisture from plant compressed air supplied to air pollution control equipment shall conform to ASTM F 1139.

2.6 THERMOMETERS

Thermometers shall conform to ASME PTC 19.3 with wells and temperature range suitable for the use encountered.

2.7 VALVES

Valves shall conform to the following:

2.7.1 Angle Valves

MSS SP-80, Types 1, 2, or 3, Class 125, except that valves over 3 inch shall have iron bodies and brass or bronze standard trim with glands or followers in the stuffing boxes. Valves shall have nonmetallic renewable composition discs and raised flat seats designed for 125 psi steam. Wheels shall be secured with hexagonal nuts.

2.7.2 Check Valves

MSS SP-80, Types 1, 2, 3, or 4, Class 125, as required. Valves over 3 inch shall have iron bodies and shall be the swing type designed for 125 psi steam. Check valves shall have renewable composition discs or shall have metallic discs of the regrinding type to permit regrinding without removing valve from the line.

2.7.3 Gate Valves

Sizes of 1-1/2 inch or less, MSS SP-80, Class 125, Type 1 and 2; 2 inch size and over, MSS SP-70, Class 125 or 250, as specified; outside screw and yoke with threaded end (design OT), or flanged end (design OF), as required.

2.7.4 Globe Valves

MSS SP-80, Type 1. Valves over 3 inch shall have iron bodies and brass or bronze standard trim and shall have glands or followers in the stuffing boxes. Valves shall have nonmetallic renewable composition discs and

raised flat seats designed for 150 psi steam. Wheels shall be secured to the stems with hexagonal nuts.

2.8 WATER METERS

Water meters shall be the disc type with reinforced disc for hot water above 150 degrees F, and rubber or carbon disc for cold water, and shall be constructed of bronze composition or cast iron protected by noncorrosive coating. Moving parts subject to wear shall be easily replaceable. Meters shall conform to the requirements of AWWA C700.

2.9 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical equipment and wiring shall be in accordance with Section 26 20 00. Electrical characteristics shall be as indicated or specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control specified. Each motor shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified but not shown, shall be provided. Motors shall conform to NEMA MG 1, with enclosures as indicated. Controls, interlocks, instruments, status indication lights, and other devices required for operation and observation of equipment status shall be assembled on an open face panel. Panel shall be factory assembled and boxed for field installation. Instrumentation and control system shall include local control panels and a central control panel located in the facility control room. The control system shall integrate local controls provided with equipment, as specified, so that complete system operation can be monitored and controlled from the control room. The air pollution control system shall be integrated with the emission generating equipment. The control system shall provide integrated control of all system processes and equipment, and shall contain all necessary instrumentation required for monitoring and operation of the air pollution control system. Control system panels shall graphically display the system. Local control panels shall be provided with selector switches so that equipment can be operated manually for test and maintenance purposes. Suitable safety interlocks shall be incorporated to assure that proper permissive conditions have been met prior to changing the operating status of major system components. Shutdown of the air pollution control equipment system, or portion thereof, shall be automatically initiated, with alarms should unsafe conditions arise during operation of the system. Visible and audible alarms shall be provided on critical functions locally. and at central control room. Controls shall conform to NEMA ICS 1. Enclosures for power and control panels shall conform to NEMA ICS 6.

2.10 DUCTWORK

Ductwork shall be designed to convey air with a minimum of pressure loss due to friction. Ducts shall be straight and smooth on the inside with laps made in the direction of airflow. Ducts shall be externally braced and shall be so installed and anchored as to be free of vibration. Access and inspection doors shall be provided as indicated, with a minimum of one in each section between dampers or items of equipment. Ducts shall be constructed with long radius elbows having a centerline radius of 1.5 times the duct width, or where the space does not permit the use of long radius elbows, short radius or square elbows with factory-fabricated turning vanes

may be used. Duct joints shall be substantially air-tight and shall have adequate strength for the service.

2.11 AIR POLLUTION CONTROL EQUIPMENT

Performance of equipment shall be as indicated in Paragraph SCHEDULES. Air and water piping shall comply with ASME B31.1. Particulate emission control equipment shall conform to ASME PTC 38. Equipment shall be provided with steel walkways, safety rails and stairs, or ladders as indicated. Access shall be by means of caged ladders.

2.11.1 Selective Catalytic Reduction (SCR) System

System shall be designed to reduce nitrogen oxides from processed gas stream. System shall use ammonia as the reducing agent. System shall include all equipment required for a complete, operable SCR system, including, but not limited to, ammonia delivery system, catalytic reactor instrumentation and controls for safe, reliable operation of the system, and other pollution control devices as required.

2.11.1.1 Ammonia Delivery System

Ammonia delivery system shall include all components required for storage, preparation, and delivery of ammonia to the flue gas stream upstream of the economizer, prior to the catalytic reactor. Ammonia cylinder storage shall comply with the requirements of the Santa Clara County HazMat Program Ordinance Code Division B11, including ventilated gas cylinder cabinets, exhaust gas treatment, as needed. The ammonia delivery system shall be designed to automatically deliver ammonia based on the quantity of NOx detected in the gas stream. Ammonia distributors shall be designed to ensure uniform ammonia distribution in the gas stream. Ammonia distributors shall be located in ductwork at a sufficient distance upstream of the catalytic reactor to provide complete mixing of ammonia and flue gas prior to the catalytic reactor inlet.

No more than 500 lbs. and no less than 425 lbs. of ammonia shall be stored in a stationary ASME horizontal pressure vessel designed for anhydrous ammonia storage. Typical dimensions of a storage tank, approximately 65" long and 24" diameter (typical Roy E. Hanson Jr. Mfg., Model N-120 or equivalent). The tank shall be equipped with nozzles for the following service: 1" for fill valve, ¾" for excess flow valve for vapor to process, ¾" for rupture disc/pressure relief valve assembly, TBD" for fixed liquid level gauge/pressure gauge, TBD" for liquid level float gauge, and TBD" for level element with remote readout. There shall be a ¾" nozzle on the bottom for an excess flow valve and drain. There shall also be one spare ¾" nozzle (top) to facilitate retrofitting a vaporizer to the tank if required in the future.

The ¾" vapor line to process shall include an excess flow valve, two isolation block valves, an emergency shutoff valve operated by one of four emergency buttons (one in the control room and three in the field), an operatioanl shut off valve, a pressure equalizing valve (used during tank filling), a PRV regulating ammonia to the process to 50 psig, and a rupture disc/PSV assembly. The rupture disc/ PSV assembly on the vapor line and the pressure relief assembly on the tank shall vent into a common 1" line that is routed to the ammonia diffusion tank. The tank rupture discs shell relieve at 238.5 psi and the PSVs at 265 psi.

Inadvertent releases of ammonia via the pressure relief assemblies are

captured in an ammonia diffusion tank (ADT). The ADT shall be a 4' dia X 8' tall tank (nominal 750 gal tank) initially filled with a minimum of 595 gal of water but no more than 625 gal. This initial water inventory is designed to absorb 500 lbs of ammonia and remain below the boiling point of the resulting aqua ammonia solution (to be verified by the ADT vendor). The maximum release rate (TBD) through the tank pressure relief assembly shall dictate the ADT sparger tube size.

ADT design shall be per 2010 California Building Code and 2009 Uniform Mechanical Code. The tank shall be carbon steel. All surfaces shall be prepared and primed as required for the applicable coatings. Interior coating: bottom, top and shell, two coats of Fabertite (5 mils MDFT). Exterior coating: bottom, one coat Fabertite (5 mils MDFT); shell and top, heavy duty durethane enamel top coat (white, 3 mils MDFT) plus one coat Fabertite (5 mils MDFT) over the Durethane on bottom 10" of the shell.

The ADT shall have three anchor points and the following features as a minimum. Top shall have a 20" inspection hatch, a 3" vent cap with screen, and a 2" ammonia inlet (pending verification of the sparger size). Shell shall have 3" drain, 24" manway, and two 1" FNPT couplings for sight glass. (These features are typical of ammonia diffusion tanks by BlueScope Water Solutions, Inc.) There shall also be the following non-standard couplings: two 1" FNPT for temperature instrumentation and ½" for sample port.

2.11.1.2 Catalytic Reactor

Catalytic reactor shall provide environment for chemical reaction between ammonia and nitrogen oxides, to produce elemental nitrogen and water as the products. Catalytic reactor configuration shall provide for uniform gas flow through all elements of the reactor. Catalytic reactor shall be of gas tight construction Catalytic reactor shall be located between boiler economizer and boiler air preheater.

2.12 FACTORY APPLIED INSULATION

The equipment and appurtenances requiring insulation shall be insulated with materials, jacketing, and finishes, as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.13 PAINTING AND FINISHING

Equipment and component items shall be factory primed and finish coated with the manufacturer's standard finish. Items located outside the building shall have weather resistant finish. Damaged finish surfaces shall be refinished with an identical type of finish used at the factory.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the COR of any discrepancy before performing the work.

3.2 INSTALLATION

Work shall be installed as indicated and in accordance with manufacturer's diagrams and written instructions. A factory installation specialist shall be at the site for erection of selective catalytic reduction system. Field

applied insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.3 OPERATION AND PERFORMANCE REQUIREMENTS

Air pollution control equipment shall process and remove pollutants from exhaust gas streams to produce an effluent that will conform to 40 CFR 50 and other federal, state, and local regulations, without degrading the performance of related system components. The air pollution control equipment installed shall perform the cleaning operation as indicated on the Air Pollution Equipment Performance Data forms attached to this section.

3.4 FRAMED INSTRUCTIONS

Framed instructions containing wiring and control diagrams under glass or in laminated plastic shall be posted where directed. The instructions shall show wiring and control diagrams and complete layout of the entire system. The instructions shall include, in typed form, condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation and procedures for safely starting and stopping the system. The framed instructions shall be posted before acceptance testing of the system.

3.5 TESTING AND INSPECTIONS

3.5.1 System Performance Test

Upon completion, and prior to acceptance of the project, the air pollution control equipment and monitoring system shall be tested in accordance with 40 CFR 60, Appendix A and state and local codes by an independent testing organization to demonstrate indicated performance. A factory startup specialist shall be at the site to direct and monitor startup for testing of selective catalytic reduction system. Notify the COR 20 days in advance of the test date. The independent testing organization shall furnish all instruments and personnel required for the tests. Submit the applicable test procedures and sampling locations to the Government for approval. Electricity and water will be furnished by the Government.

3.5.2 Retesting

If any deficiencies are revealed during test, such deficiencies shall be corrected and the tests reconducted.

3.6 MANUFACTURER'S FIELD SERVICE

3.6.1 Installation

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the specified equipment shall be provided. The representative shall supervise the installing, adjusting, and testing start-up of the equipment.

3.6.2 Training

Conduct training course for operating staff as designated by the COR. The training period, of a total of 20 hours of normal working time, shall start after the system is functionally completed, but prior to final acceptance tests. The field instructions shall cover all of the items contained in the operating and maintenance instructions, as well as demonstrations of

routine maintenance operations. The COR shall be notified at least 14 days prior to date of proposed conduction of training course.

3.7 CLOSEOUT ACTIVITIES

3.7.1 Operation and Maintenance Manuals

Provide six complete copies of operation manual outlining the step-by-step procedures required for system startup, operation, and shutdown. The manuals shall include the manufacturer's name, model number,service manual, parts list, and brief description of all equipment and its basic operating features. The operations manual shall include instructions specific to operating the ammonia tank system (ammonia storage and ammonia diffusion tank) in an emergency situation. This shall include instructions on (a) the emergency button/horn/beacon system (emergency shutoff and audible/visible notification of personnel of a potentially dangerous situation in the field), (b) the manual shutoff operated from the control room, and (c) maintenance of the dual PSV assembly and Ammonia Diffusion Tank in proper standby status so that it is ready to receive an inadvertent release from pressure safety valves.

Provide six complete copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repair, and troubleshooting guides. The manuals shall include piping layout, equipment layout, and simplified wiring and control diagrams of the system as installed. Operation and maintenance manuals shall be approved prior to training course. Submit six manuals at least 2 weeks prior to field training.

3.8 SCHEDULES

SCR Performance Requirement:

See boiler equipment schedule for NO_x limits allowed at the stock.

Flue Gas Composition and Flow Rate:

See boiler manufacturer's submittals when they are available.

-- End of Section --