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NEXT ASSY	USED ON			SYM	DESCRIPTION	DATE	APPROVAL
				B	01 11 00, 26 05 71.00 40, 33 01 30.72, and 33 32 13.13 revised.	3/31/11	

TECHNICAL SPECIFICATIONS FOR DRAWING 79K38703 REV B

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	DRAFTSMAN	CHECKER		
MATERIAL	TRACER	CHECKER		
	ENGINEER	ENGINEER		
HEAT TREATMENT	SUBMITTED K. MILLER, TA-B3A 3/31/2011		SCALE	DWG SIZE: A — 79K38704 REV B
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KSC FORM 21-2 (REV 9/65) (C/G 7/97)

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SECTION 01 11 00

SUMMARY OF WORK

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 E 2114	(2008) Standard Terminology for Sustainability Relative to the Performance of Buildings

1.2 DEFINITIONS

Definitions pertaining to sustainable development are as defined in ASTM E 2114, Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION, 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. "Sustainability" is the balance of environmental, economic, and societal considerations.

1.3 SUBMITTALS

Not used.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

1.4.1 Project Description

1. The work includes the repair and replacement of gravity sewer manholes and pipelines in various locations across Kennedy Space Center, based on a revalidated prioritization list developed in the Phase II wastewater study.

2. The work consists of demolition and replacement of existing lift station components at lift stations LS-1AA, LS-1L, LS-4A, LS-4B, LS-4N1, LS-4S, LS-9A, LS-10A, and LS-12A. Demolition includes, but is not limited to, dismantling, scrapping items, decommissioning utilities, preparation, and disposal. Replacement of components includes, but is not limited to, replacing pumps, valves, control panels, floats, riser pipes, and wet well. The lift station upgrades will include installation of a SCADA Telemetry System to monitor pressure, pump status, and alarms at selected stations. Replace LS-4B and LS-9A in their entirety.

1.4.2 Location

The work shall be located at the Industrial Area and VAB Area, approximately as indicated on the drawings. The exact locations will be shown by the Contracting Officer.

1.5 CONTRACT DRAWINGS

The following drawings accompany this specification and are a part thereof.

Drawing No. 79K38703
Sheets 1 through 83

The publications of the issues of referenced documents in effect on the date of issuance of invitation for bids form a part of this specification and, where referred to herein by basic designation only, are applicable to the extent indicated by the references thereto. In the event of difference between this specification or its accompanying drawings and the referenced document, this specification and its accompanying drawings must govern to the extent of such difference.

1.6 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 recycled materials. These items, when incorporated into the work under this contract, must contain at least the specified percentage of recycled or recovered material.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

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-- End of Section Table of Contents --

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

The Contracting Officer 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. Picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations samples remaining upon completion of the work.

1.1 DEFINITIONS

1.1.1 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 prior to a notice to proceed commencing work on site. Submittals required prior to the start of the next major phase of the construction on a multi-phase contract. Schedules or 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, submitted prior to contract notice to proceed or next major phase of construction.

Certificates of insurance
Surety bonds
List of proposed subcontractors
List of proposed products
Construction Progress Schedule
Network Analysis Schedule (NAS)

Submittal register
Schedule of prices
Safety and health 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.

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.

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 Material Safety Data sheets 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.

1.1.2 Approving Authority

Office or designated person authorized to approve submittal.

1.1.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.2 SUBMITTALS

Not used.

1.3 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.3.1 Government Approved

Government approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Government approval is required for any deviations from the Solicitation or Accepted Proposal and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.3.2 Information Only

Submittals not requiring 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.

1.4 FORWARDING SUBMITTALS REQUIRING GOVERNMENT APPROVAL

1.4.1 Submittals Required from the Contractor

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

The Government will review and approve for the Contracting Officer those submittals reserved for Contracting Officer approval to verify submittals

comply with the contract requirements.

1.4.1.1 O&M Data

The Government will review and approve for the Contracting Officer O&M Data to verify the submittals comply with the contract requirements; submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

a. In the event the Contractor fails to deliver O&M Data within the time limits specified, the Contracting Officer may withhold from progress payments 50 percent of the price of the item with which such O&M Data are applicable.

1.5 PREPARATION

1.5.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels to office of approving authority. Transmit submittals with transmittal form prescribed by Contracting Officer and standard for project. On the transmittal form identify Contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled "Identifying Submittals." Process transmittal forms to record actions regarding sample installations.

1.5.2 Identifying Submittals

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

Identify submittals, except sample installations and sample panels, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title and location.

b. Construction contract number.

c. Date of the drawings and revisions.

d. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other subcontractor associated with the submittal.

e. Section number of the specification section by which submittal is required.

f. Submittal description (SD) number of each component of submittal.

g. When a resubmission, add alphabetic suffix on submittal description, for example, submittal 18 would become 18A, to indicate resubmission.

h. Product identification and location in project.

1.5.3 Format for SD-02 Shop Drawings

a. Shop drawings are not to be 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.

b. Present A4 8 1/2 by 11 inches sized shop drawings as part of the bound volume for submittals required by section. Present larger drawings in sets.

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

d. 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.

e. Reserve a blank space, no smaller than 4 inches on the right hand side of each sheet for the Government disposition stamp.

f. 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.

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

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

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

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

c. 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.

d. Provide product data in metric dimensions. Where product data are included in preprinted catalogs with English units only, submit metric dimensions on separate sheet.

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

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

f. 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 Contracting Officer. 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.

g. 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 not be accepted for expedition of construction effort.

h. Submit manufacturer's instructions prior to installation.

1.5.5 Format of SD-04 Samples

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

(1) Sample of Equipment or Device: Full size.

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

(3) Sample of Materials Exceeding 8 1/2 by 11 inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.

(4) Sample 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.

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

Provide design data and certificates on 8 1/2 by 11 inches paper. Provide a bound volume for submittals containing numerous pages.

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

a. Provide reports on 8 1/2 by 11 inches paper in a complete bound volume.

b. Indicate by prominent notation, each report in the submittal.

Indicate specification number and paragraph number to which it pertains.

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

Comply with the requirements specified in Section 01 78 00 CLOSEOUT SUBMITTALS for O&M Data format.

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

a. 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.

1.6 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer 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 Contracting Officer 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.

1.7 VARIATIONS / SUBSTITUTION REQUESTS

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

1.7.1 Considering Variations

Discussion with Contracting Officer 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.

1.7.2 Proposing Variations

When proposing variation, deliver written request to the Contracting Officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Government. 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.

1.7.3 Warranting That Variations Are Compatible

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

1.7.4 Review Schedule Is Modified

In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the Government of submittals with variations.

1.8 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. For submittals requiring review by fire protection engineer, allow review period, beginning when Government receives submittal from the Contractor, of 21 working days for return of submittal to the Contractor.

c. Period of review for each resubmittal is the same as for initial submittal.

At the Preconstruction conference, provide, for approval by the Contracting Officer, the following schedule of submittals:

a. A schedule of shop drawings and technical submittals required by the specifications and drawings. Indicate the specification or drawing reference requiring the submittal; the material, item, or process for which the submittal is required; the "SD" number and identifying title of the submittal; the Contractor's anticipated submission date and the approval need date.

b. A separate schedule of other submittals required under the contract but not listed in the specifications or drawings. Schedule will indicate the contract requirement reference; the type or title of the submittal; the Contractor's anticipated submission date and the approved need date (if approval is required).

1.8.1 Reviewing, Certifying, Approving Authority

The Contractor is responsible for reviewing and certifying that submittals are in compliance with contract requirements. At each "Submittal" paragraph in individual specification sections, a notation "G," following a submittal item, indicates Contracting Officer is approving authority for that submittal item.

1.8.2 Constraints

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

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

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

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

1.9 GOVERNMENT APPROVING AUTHORITY

When approving authority is Contracting Officer, the Government will:

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

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

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

Upon completion of review of submittals requiring Government approval, stamp and date approved submittals.

1.9.1 Review Notations

Contracting Officer review will be completed within 14 calendar 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" "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" or "disapproved," 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.

1.10 DISAPPROVED SUBMITTALS

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.

1.11 APPROVED SUBMITTALS

The Contracting Officer's approval or acceptance of submittals is not 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 is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.12 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 Contracting Officer 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 Contracting Officer does not relieve the Contractor of his responsibilities under the contract.

1.13 STATUS REPORT ON MATERIALS ORDERS

Within 30 calendar days after notice to proceed, submit, for approval by the Contracting Officer, an initial material status report on all materials

orders. This report will be updated and re-submitted every 30 calendar days as the status on material orders changes.

Report to include list, in chronological order by need date, materials orders necessary for completion of the contract. The following information will be required for each material order listed:

a. Material name, supplier, and invoice number.

b. Bar chart line item or CPM activity number affected by the order.

c. Delivery date needed to allow directly and indirectly related work to be completed within the contract performance period.

d. Current delivery date agreed on by supplier.

e. When item d exceeds item c, the effect that delayed delivery date will have on contract completion date.

f. When item d exceeds item c, a summary of efforts made by the Contractor to expedite the delayed delivery date to bring it in line with the needed delivery date, including efforts made to place the order (or subcontract) with other suppliers.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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GOVERNMENTAL SAFETY REQUIREMENTS

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.

ASME INTERNATIONAL (ASME)

ASME B30.22	(2005) Articulating Boom Cranes
ASME B30.3	(2009) Construction Tower Cranes
ASME B30.5	(2007) Mobile and Locomotive Cranes

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA NPG 8621.1	(2004a) NASA Mishap Reporting, Investigating and Record Keeping Policy
NASA NSS 1740.12	(1993) NASA Safety Standard For Explosives, Propellants and Pyrotechnics

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2007; Errata 2007; AMD 1 2007) Standard for Portable Fire Extinguishers
NFPA 51B	(2009) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	(2008; AMD 1 2008) National Electrical Code - 2008 Edition
NFPA 70E	(2009; Errata 2009) Standard for Electrical Safety in the Workplace

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

29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.500	Fall Protection

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00

SUBMITTAL PROCEDURES:

Government acceptance is required for submittals with a "G" designation.

SD-01 Preconstruction Submittals

Safety and Health Plan; G

Proof of qualification for Crane Operators; G

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

SD-07 Certificates

Confined Space Entry Permit

Hot work permit

Certificate of Compliance (Crane)

1.3 DEFINITIONS

a. Competent Person for Fall Protection. A person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as their application and use with related equipment, and has the authority to take prompt corrective measures to eliminate the hazards of falling.

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

c. 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.

d. Operating Envelope. The area surrounding any crane. Inside this "envelope" is the crane, the operator, riggers and crane walkers, rigging gear between the hook and the load, the load and the crane's supporting structure (ground, rail, etc.).

e. Qualified Person for Fall Protection. A person with a recognized degree or professional certificate, and with extensive knowledge, training and experience in the field of fall protection; who is capable of performing design, analysis, and evaluation of fall protection systems and equipment.

f. 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.

h. 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.)

1.4 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with the most recent addition of federal, state, and local laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards 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 govern.

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 Site 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. 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 Contracting Officer in consultation with the Safety Office.

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.

1.5.1.3 Competent Person for Confined Space Entry

Provide a competent person for confined space.

1.5.1.4 Crane Operators

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 production 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, or any other assigned safety and health professionals who participated in the development of the APP Safety and Health Plan.

b. Discuss the details of the submitted Safety and Health Plan.

c. Deficiencies in the submitted Safety and Health Plan 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 Safety and Health Plan.

1.5.3.2 Safety Meetings

Conduct and document meetings daily as required. Attach minutes showing contract title, signatures of attendees and a list of topics discussed to the Contractors' daily production report.

1.6 DISPLAY OF SAFETY INFORMATION

Within 1 calendar days 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 Contracting Officer, that is accessible and includes all mandatory information for employee and visitor review, shall be deemed as meeting the requirement for a bulletin board. Additional items required to be posted include:

a. Confined space entry permit.

b. Hot work permit.

1.7 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.

1.8 EMERGENCY MEDICAL TREATMENT

Emergency medical treatment is available to the Contractor by calling 321-867-7911. Medical facilities are located in the VAB area and Industrial Area as shown below.

Medical	
Occupational Health Facility 2nd and C Avenue Hours: 7:00 a.m. to 5:00 p.m., Mon-Fri	321-867-3346

Medical	
LC 39 Area Clinic Utility Road and VAB Road Hours: 7:00 a.m. to 3:30 p.m., Mon-Fri	321-867-3360

1.9 REPORTS

1.9.1 Accident Reports

a. Conduct an accident investigation for recordable injuries and illnesses, as defined in 1.3.h and property damage accidents resulting in at least $2,000 in damages, to establish the root cause(s) of the accident and provide the report to the Contracting Officer within 5 calendar day(s) of the accident. The Contracting Officer 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 Contracting Officer 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 contracting officer. The Contracting Officer will provide a blank copy of the accident report form.

1.9.2 Accident Notification

Notify the Contracting Officer as soon as practical, but not later than four 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 NPG 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.

1.9.3 Crane Reports

Submit crane inspection reports as specified herein with Daily Reports of Inspections.

1.9.4 Certificate of Compliance

Provide a Certificate of Compliance for each crane entering an activity under this contract. State within the certificate that the crane and rigging gear meet applicable OSHA regulations (with the Contractor citing which OSHA regulations are applicable, e.g., cranes used in construction, demolition, or maintenance comply with 29 CFR 1926. Certify on the Certificate of Compliance that the crane operator(s) is qualified and trained in the operation of the crane to be used.

1.10 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 Fire Division. 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 Fire Division phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED IMMEDIATELY.

1.11 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 Contracting Officer.

1.12 WELDING

Toxic paint may exist on metals. Contractor shall require their employees to wear the proper PPE during welding activities.

1.13 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 with the Facility Manager. Use of any such equipment shall be approved in writing by the Contracting Officer prior to commencement of work.

1.14 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.

1.15 CONFINED SPACE ENTRY REQUIREMENTS

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

PART 2 PRODUCTS

Not used.

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 29 CFR 1926, 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 Federal and/or State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

3.2 PRE-OUTAGE COORDINATION MEETING

Contractors are required to apply for utility outages at least 14 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 Contracting Officer 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.

Contracting Officer 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 Contracting Officer. That group's or individual's lockout/tagout tags on equipment may then be removed on authorization by the Contracting Officer.

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 29 CFR 1926.

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 at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in 29 CFR 1926. 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.

3.4.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet 29 CFR 1926. 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 Fall Protection for Roofing Work

Implement fall protection controls based on the type of roof being constructed and work being performed. Evaluate the roof area to be accessed for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

(1) For work within 6 feet of an edge, on low-slope roofs, Protect personnel from falling by use of personal fall arrest systems, guardrails, or safety nets. A safety monitoring system is not

adequate fall protection and is not authorized.

(2) For work greater than 6 feet from an edge, erect and install warning lines in accordance with 29 CFR 1926.500.

b. Steep-Sloped Roofs: Work on steep-sloped roofs requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also includes residential or housing type construction.

3.4.4 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 29 CFR 1926. Exiting horizontal lifeline anchorages must be certified (or re-certified) by a registered professional engineer with experience in designing horizontal lifeline systems.

3.4.5 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).

3.4.6 Guardrails and Safety Nets

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

3.4.7 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 Fall Protection and Prevention (FP&P) Plan and the Safety and Health Plan.

3.5 SCAFFOLDING

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 the Safety and Health Plan for the phase of work.

3.5.1 Stilts

The use of stilts for gaining additional height in construction, renovation, repair or maintenance work is prohibited.

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. Notify the Contracting Officer 15 days in advance of any cranes entering the activity so that necessary quality assurance spot checks can be coordinated. Contractor's operator shall remain with the crane during the spot check.

b. Comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in ASME B30.5). Perform all testing in accordance with the manufacturer's recommended procedures.

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

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 OSHA 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 Contracting Officer 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 Contracting Officer personnel.

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

o. Take steps to ensure that wind speed does not contribute to loss of control of the load during lifting operations. Prior to conducting lifting operations set a maximum wind speed at which a crane can be safely operated based on the equipment being used, the load being lifted, experience of operators and riggers, and hazards on the work site. This maximum wind speed determination shall be included as part of the activity hazard analysis plan for that operation.

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.

3.6.4 USE OF EXPLOSIVES

Explosives shall not be used or brought to the project site without prior written approval from the Contracting Officer. 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 NSS 1740.12. 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. Manufacture tabulated data and specifications or 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 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 utility departments. 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 Contracting Officer and Station Utilities for identification. The Contracting Officer 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 the Contractor to work near energized circuits as defined by the NFPA 70, 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 Safety and Health Plan.

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 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.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. All hazards pertaining to the space shall be reviewed with each employee during review of the Safety and Health Plan.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.

c. All underground structures require continuous atmosphere monitoring with audible alarm for toxic gas detection.

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SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B 564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

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SECTION 01 57 20.00 10

ENVIRONMENTAL PROTECTION

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.

U.S. ARMY CORPS OF ENGINEERS (USACE)

WETLAND MANUAL	Corps of Engineers Wetlands Delineation Manual Technical Report Y-87-1

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

33 CFR 328	Definitions of Waters of the United States
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 273	Standards For Universal Waste Management
40 CFR 279	Standards for the Management of Used Oil
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 355	Emergency Planning and Notification
40 CFR 68	Chemical Accident Prevention Provisions
49 CFR 171 - 178	Hazardous Materials Regulations

1.2 DEFINITIONS

1.2.1 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.2.2 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of

land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2.3 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners,excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

1.2.4 Land Application for Discharge Water

The term "Land Application" for discharge water implies that the Contractor must discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" must occur. Land Application must be in compliance with all applicable Federal, State, and local laws and regulations.

1.2.5 Surface Discharge

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers,creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

1.2.6 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.2.7 Wetlands

Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland must be done in accordance with WETLAND MANUAL.

1.2.8 Universal Waste

Universal Waste means any of the following hazardous wastes that are managed under the universal waste requirements 40 CFR 273:

(1) Batteries as described in Sec. 273.2 of this chapter;
(2) Pesticides as described in Sec. 273.3 of this chapter;
(3) Thermostats as described in Sec. 273.4 of this chapter; and
(4) Lamps as described in Sec. 273.5 of this chapter.

1.3 GENERAL REQUIREMENTS

Minimize environmental pollution and damage that may occur as the result of

construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work must be protected during the entire duration of this contract. Comply with all applicable environmental Federal, State, and local laws and regulations. Any delays resulting from failure to comply with environmental laws and regulations will be the Contractor's responsibility.

1.4 SUBCONTRACTORS

Ensure compliance with this section by subcontractors.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G

The environmental protection plan.

1.6 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, submit an Environmental Protection Plan for review and approval by the Contracting Officer. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern must be defined within the Environmental Protection Plan as outlined in this section. Address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but are considered necessary, must be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, meet with the Contracting Officer for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. The Environmental Protection Plan must be current and maintained onsite by the Contractor.

1.6.1 Compliance

No requirement in this Section will relieve the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor will be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.6.2 Contents

Include in the environmental protection plan, but not limit it to, the following:

a. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental

Protection Plan.

b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.

c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

d. Description of the Contractor's environmental protection personnel training program.

e. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan must include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.

f. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.

g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

h. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.

i. Drawing showing the location of borrow areas.

j. Include in the Spill Control plan the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The Spill Control Plan supplements the requirements the contract clause "Spills". Include in this plan, as a minimum:

1). The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual will immediately notify the Contracting Officer and NASA Environmental. Include in the plan a list of the required reporting channels and telephone numbers.

2). The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup.

3). Training requirements for Contractor's personnel and methods of accomplishing the training.

4). A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential

hazard(s) identified.

5). The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

6). The methods and procedures to be used for expeditious contaminant cleanup.

k. A hazardous waste disposal plan identifying methods and locations for hazardous waste and universal waste collection and disposal.

l. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris and schedules for disposal.

1). Identify any subcontractors responsible for the transportation and disposal of solid waste. Submit licenses or permits for solid waste disposal sites that are not a commercial operating facility.

2). Evidence of the disposal facility's acceptance of the solid waste must be attached to this plan during the construction. Attach a copy of each of the Non-hazardous Solid Waste Diversion Reports to the disposal plan. Submit the report for the previous quarter on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted (e.g. the first working day of January, April, July, and October).

3). Indicate in the report the total amount of waste generated and total amount of waste diverted in cubic yards or tons along with the percent that was diverted.

m. A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. Detail in the plan the Contractor's actions to comply with and to participate in Federal, State, Regional, and local government sponsored recycling programs to reduce the volume of solid waste at the source.

n. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

o. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. A copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be onsite at any given time must be included in the contaminant prevention plan. Update the plan as new hazardous materials are brought onsite or removed from the site.

p. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water,

hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, the plan must include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, the plan must include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, include a copy of the permit and associated documents as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, the plan must include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge.

q. A historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in the area are discovered during construction. Include in the plan methods to assure the protection of known or discovered resources, identifying lines of communication between Contractor personnel and the Contracting Officer.

1.6.3 Appendix

Attach to the Environmental Protection Plan, as an appendix, copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents.

1.7 PROTECTION FEATURES

Prior to the start of any onsite construction activities, the Contractor and the Contracting Officer will make a joint condition survey. Immediately following the survey, the Contractor will prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report will be signed by both the the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor must protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the work under the contract.

1.8 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations from the drawings, plans and specifications, requested by the Contractor and which may have an environmental impact, will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

1.9 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. After receipt of such notice, the Contractor will inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions will be granted or equitable adjustments allowed for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 LAND RESOURCES

Confine all activities to areas defined by the drawings and specifications. Identify any land resources to be preserved within the work area prior to the beginning of any construction. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval, except in areas indicated on the drawings or specified to be cleared. Ropes, cables, or guys will not be fastened to or attached to any trees for anchorage unless specifically authorized. Provide effective protection for land and vegetation resources at all times, as defined in the following subparagraphs. Remove stone, soil, or other materials displaced into uncleared areas.

3.1.1 Work Area Limits

Mark the areas that need not be disturbed under this contract prior to commencing construction activities. Mark or fence isolated areas within the general work area which are not to be disturbed. Protect monuments and markers before construction operations commence. Where construction operations are to be conducted during darkness, any markers must be visible in the dark. The Contractor's personnel must be knowledgeable of the purpose for marking and/or protecting particular objects.

3.1.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved must be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. Restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.1.3 Erosion and Sediment Controls

Providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations is the Contractor's responsibility. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. Construct or install

temporary and permanent erosion and sediment control best management practices (BMPs) as indicated on the drawings and as specified in Section 01 57 23 TEMPORARY STORM WATER POLLUTION CONTROL. BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. The Contractor's best management practices must also be in accordance with the National Pollutant Discharge Elimination System (NPDES) Storm Water Pollution Prevention Plan (SWPPP) which may be reviewed at NASA Environmental. Remove any temporary measures after the area has been stabilized.

3.1.4 Contractor Facilities and Work Areas

Place field offices, staging areas, stockpile storage, and temporary buildings in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities will be made only when approved. Erosion and sediment controls must be provided for onsite borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas must be controlled to protect adjacent areas.

3.2 WATER RESOURCES

Monitor all water areas affected by construction activities to prevent pollution of surface and ground waters. Do not apply toxic or hazardous chemicals to soil or vegetation unless otherwise indicated. For construction activities immediately adjacent to impaired surface waters, the Contractor must be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally issued Clean Water Act permits.

3.2.1 Cofferdams, Diversions, and Dewatering Operations

Construction operations for dewatering shall be controlled at all times to maintain compliance with existing State water quality standards and designated uses of the surface water body. Comply with the contract clause "Dewatering/Consumptive Use Permit (CUP)".

3.2.2 Wetlands

Do not enter, disturb, destroy, or allow discharge of contaminants into any wetlands.

3.3 AIR RESOURCES

Equipment operation, activities, or processes will be in accordance with all Federal and State air emission and performance laws and standards.

3.3.1 Particulates

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphaltic batch plants; must be controlled at all times, including weekends, holidays and hours when work is not in progress. Maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which

would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. Provide sufficient, competent equipment available to accomplish these tasks. Perform particulate control as the work proceeds and whenever a particulate nuisance or hazard occurs. Comply with all State and local visibility regulations.

3.3.2 Odors

Odors from construction activities must be controlled at all times. The odors must be in compliance with State regulations and/or local ordinances and may not constitute a health hazard.

3.3.3 Sound Intrusions

Keep construction activities under surveillance and control to minimize environment damage by noise. Comply with State regulations and local ordinances.

3.3.4 Burning

Burning is prohibited on the Government premises.

3.4 MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes will be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.4.1 Solid Wastes

Solid wastes (excluding clearing debris) shall be handled in accordance with the contract clause "Landfill Operations/Solid Waste Removal".

3.4.2 Chemicals and Chemical Wastes

Dispense chemicals ensuring no spillage to the ground or water. Perform and document periodic inspections of dispensing areas to identify leakage and initiate corrective action. This documentation will be periodically reviewed by the Government. Collect chemical waste in corrosion resistant, compatible containers. Collection drums must be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be classified, managed, stored, and disposed of in accordance with the contract clause "Hazardous Waste".

3.4.3 Hazardous Materials and Universal Waste/Contractor General Hazardous Wastes

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. Manage and store hazardous waste and universal waste in compliance with 40 CFR 262 and the contract clause "Hazardous Waste". Take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing.

3.4.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles must be

conducted in a manner that affords the maximum protection against spill and evaporation. Manage and store fuel, lubricants and oil in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded must be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations and the contract clause "Hazardous Waste".

3.4.5 Waste Water

Disposal of waste water will be as specified below.

a. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. shall be in accordance with the contract clause "Concrete Wastewater".

b. For discharge of ground water, the Contractor shall land apply on the project site in accordance with all Federal, State, Regional, and/or Local laws and regulations for pumping and land applying ground water as well as the contract clause "Dewatering/Consumptive Use Permit (CUP)".

c. Water generated from the flushing of lines after disinfection or disinfection in conjunction with hydrostatic testing will be land applied in accordance with all Federal, State, and local laws and regulations for land application.

3.4.6 PCB Management

Polychlorinated Biphenyl (PCB) wastes shall be managed in accordance with the contract clause "PCB Management".

3.5 RECYCLING AND WASTE MINIMIZATION

Participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project. Recycle material in accordance with the contract clause "Recycling and Salvaging Materials". For further information, please contact the NASA/KSC Recycling Manager.

3.6 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT

Maintain an inventory of non-hazardous solid waste diversion and disposal of construction and demolition debris. Submit a report to the Environmental Program Branch through the Contracting Officer on the first working day after each fiscal year quarter, starting the first quarter that non-hazardous solid waste has been generated. Include the following in the report:

a. Construction and Demolition (C&D) Debris Disposed = _____ in cubic yards or tons, as appropriate.

b. Construction and Demolition (C&D) Debris Recycled = _____ in cubic yards or tons, as appropriate.

c. Total C&D Debris Generated = _____ in cubic yards or tons, as appropriate.

d. Waste Sent to Waste-To-Energy Incineration Plant (This amount should not be included in the recycled amount) = _____ in cubic yards or tons, as appropriate.

e. Metal Recycled = _____ in tons, as appropriate.

3.7 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

Refer to the contract clause "Historical, Architectural and Cultural Resources".

3.8 BIOLOGICAL RESOURCES

Minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The protection of threatened and endangered animal and plant species, including their habitat, is the Contractor's responsibility in accordance with Federal, State, Regional, and local laws and regulations. The Contractor shall comply with the contract clause "Biological Surveys".

3.9 SOLID WASTE MANAGEMENT UNIT (SWMU)

Portions of this project are located within the boundaries of various identified Solid Waste Management Unit (SWMU)/Potential Release Locaiton (PRL) sites being managed by the Remediation Group of NASA Environmental. A SWMU/PRL designation means that the site has had historical operations which had the potential to impact the environment.

The systems being modified are located within various SWMU or PRL sites. These sites contain groundwater contamination, soil contamination, or both. Return soil excavated from the land surface to any depth to the area of excavation from which it was removed. Collect, containerize, sample, and dispose of excavated soil that cannot be returned to the area from which it was removed in accordance with the Process Waste Questionnaire (PWQ)/Technical Response Packet (TRP) process. Wear proper PPE when working in soil and groundwater. Use best management practices to prevent erosion and removal of soil from site.

Discharge dewatering effluent to grade upland of the excavated area and allow to percolate back into the pervious ground surface. Use best management practices to prevent dewatering effluent from entering surface waters. There is a potential that dewatering effluent from SWMU or PRL sites may not be discharged to grade. Coordinate with the Contracting Officer and NASA Environmental for approval of the Dewatering Plan within the boundary of a SWMU or PRL 12 days before the Notice to Proceed.

3.10 PREVIOUSLY USED EQUIPMENT

Clean all previously used construction equipment prior to bringing it onto the project site. Ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. Consult with the USDA jurisdictional office for additional cleaning requirements.

3.11 MAINTENANCE OF POLLUTION FACILITIES

Maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.12 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel must be trained in all phases of environmental protection and pollution control. Conduct environmental protection/pollution control meetings for all personnel prior to commencing construction activities. Additional meetings must be conducted for new personnel and when site conditions change. Include in the training and meeting agenda: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.13 POST CONSTRUCTION CLEANUP

The Contractor will clean up all areas used for construction. Unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area must be graded, filled and the entire area seeded unless otherwise indicated.

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SECTION 01 57 23

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SECTION 01 57 23

TEMPORARY STORM WATER POLLUTION CONTROL

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 D 4439	(2004) Geosynthetics
ASTM D 4491	(1999a; R 2004e1) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2004) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 2003) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4873	(2002) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 832-R-92-005	(1992) Storm Water Management for Construction Activities Developing Pollution Preventions and Plans and Best Management Practices

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

40 CFR 122.26	Storm Water Discharges (Applicable to State NPDES Programs, see section 123.25)

1.2 SYSTEM DESCRIPTION

The work consists of implementing the storm water pollution prevention measures to prevent sediment from entering streams or water bodies as specified in this Section in conformance with the requirements of Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION, and the requirements of the National Pollution Discharge Elimination System (NPDES) permit.

1.3 EROSION AND SEDIMENT CONTROLS

The controls and measures required of the Contractor are described below.

1.3.1 Stabilization Practices

The stabilization practices to be implemented include temporary seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, erosion control mats, protection of trees, preservation of mature vegetation, etc. On the Daily Report, record the dates when the major grading activities occur, (e.g., clearing, excavation, and grading); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. Except as provided in paragraphs UNSUITABLE CONDITIONS and NO ACTIVITY FOR LESS THAN 21 DAYS, stabilization practices must be initiated as soon as practicable, but no more than 14 days, in any portion of the site where construction activities have temporarily or permanently ceased.

1.3.1.1 Unsuitable Conditions

Where the initiation of stabilization measures by the fourteenth day after construction activity temporarily or permanently ceases or is precluded by unsuitable conditions caused by the weather, stabilization practices shall be initiated as soon as practicable after conditions become suitable.

1.3.1.2 No Activity for Less Than 21 Days

When the total time period in which construction activity is temporarily ceased on a portion of the site is 14 days minimum, stabilization practices do not have to be initiated on that portion of the site until 14 days have elapsed after construction activity temporarily ceased.

1.3.1.3 Burnoff

Burnoff of the ground cover is not permitted.

1.3.1.4 Protection of Erodible Soils

Immediately finish the earthwork brought to a final grade, as indicated or specified, and 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.

1.3.2 Erosion, Sediment and Stormwater Control

a. Storm Water Notice of Intent for Construction Activities

b. 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 Contracting Officer prior to the commencement of work. The SWPPP shall meet the requirements of the State of Florida general permit for storm water discharges from construction sites. Submit the SWPPP along with any required Notice of Intents, Notice of Termination, and appropriate permit fees, via the Contracting Officer, to the appropriate State agency for approval, a minimum of 14 calendar days prior to the start of any land disturbing activities. Maintain an approved copy of the SWPPP at the construction on-site office, and continually update as regulations require, to reflect current site conditions. Include within the SWPPP:

(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 State of Florida general permit for storm water discharge.

(4) Select applicable best management practices from EPA 832-R-92-005.

(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 832-R-92-005. Provide an SWPPP for the project.

(7) Install, inspect, and maintain best management practices (BMPs) as required by the general permit. Prepare and submit to the Contracting Officer, BMP Inspection Reports as required by the general permit.

(8) Once construction is complete and the site has been stabilized with a final, sustainable cover, submit the Notice of Termination to the Contracting Officer and NASA Environmental within 30 days after all land disturbing activities end.

(9) At the time of submittal to the Contracting Officer, concurrently forward copies of the SWPPP, Registration Statement, BMP Inspection Reports, and Notice of Termination to the Contracting Officer and to NASA Environmental.

1.3.3 Stormwater Drainage

There will be no discharge of excavation ground water to the sanitary sewer, storm drains, or to the river without prior specific authorization from the Contracting Officer and NASA Environmental. 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 silt fence or other method suitable to the Contracting Officer and NASA Environmental. Provide erosion protection of the surrounding soils.

1.3.4 Structural Practices

Implement structural practices to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Implement structural practices in a timely manner, during the construction process, to minimize erosion and sediment runoff. Include the following devices; Location and details of installation and construction are shown on the drawings.

1.3.4.1 Silt Fences

Provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Properly install silt fences to effectively retain

sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing, excavation, and grading). Install silt fences in the locations indicated on the drawings. Obtain approval from the Contracting Officer prior to final removal of silt fence barriers.

1.3.5 Vegetation and Mulch

a. Provide temporary protection on sides and back slopes as soon as rough grading is completed or sufficient soil is exposed to require erosion protection. Protect slopes by accelerated growth of permanent vegetation, temporary vegetation, mulching, or netting. Stabilize slopes by hydroseeding, anchoring mulch in place, covering with anchored netting, sodding, or such combination of these and other methods necessary for effective erosion control.

b. Seeding: Provide new seeding where ground is disturbed. Include topsoil or nutriment during the seeding operation necessary to establish a suitable stand of grass.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Storm Water Pollution Prevention Plan
Storm Water Notice of Intent

Pollution prevention plan and Notice of intent for NPDES coverage under the general permit for construction activities

1.5 DELIVERY, STORAGE, AND HANDLING

Identify, store and handle filter fabric in accordance with ASTM D 4873.

PART 2 PRODUCTS

2.1 COMPONENTS FOR SILT FENCES

2.1.1 Filter Fabric

Provide geotextile that complies with the requirements of ASTM D 4439, and consists of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and contains stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure. Provide synthetic filter fabric that contains ultraviolet ray inhibitors and stabilizers to assure a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. The filter fabric shall meet the following requirements:

FILTER FABRIC FOR SILT SCREEN FENCE

PHYSICAL PROPERTY	TEST PROCEDURE	STRENGTH REQUIREMENT

Grab Tensile	ASTM D 4632	100 lbs. min.
Elongation (percent)		30 percent max.
Trapezoid Tear	ASTM D 4533	55 lbs. min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

2.1.2 Silt Fence Stakes and Posts

Use either wooden stakes or steel posts for fence construction. Wooden stakes utilized for silt fence construction, shall have a minimum cross section of 2 by 2 inches when oak is used and 4 by 4 inches when pine is used, and have a minimum length of 5 feet. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum weight of 1.33 pounds/linear foot and a minimum length of 5 feet.

PART 3 EXECUTION

3.1 INSTALLATION OF SILT FENCES

Extend silt fences a minimum of 16 inches above the ground surface without exceeding 34 inches above the ground surface. Provide filter fabric from a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, splice together filter fabric at a support post, with a minimum 6 inch overlap, and securely sealed. Excavate trench approximately 4 inches wide and 4 inches deep on the upslope side of the location of the silt fence. The 4 by 4 inch trench shall be backfilled and the soil compacted over the filter fabric. Remove silt fences upon approval by the Contracting Officer.

3.2 FIELD QUALITY CONTROL

Maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. Use the following procedures to maintain the protective measures.

3.2.1 Silt Fence Maintenance

Inspect the silt fences in accordance with paragraph, titled "Inspections," of this section. Any required repairs shall be made promptly. Pay close attention to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, replace the fabric promptly. Remove sediment deposits when deposits reach one-third of the height of the barrier. Remove a silt fence when it is no longer required. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall receive erosion control.

3.3 INSPECTIONS

3.3.1 General

Inspect disturbed areas of the construction site, areas that have not been finally stabilized used for storage of materials exposed to precipitation, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Conduct inspections at least once every month where sites have been finally stabilized.

3.3.2 Inspections Details

Inspect disturbed areas and areas used for material storage that are exposed to precipitation for evidence of, or the potential for, pollutants entering the drainage system. Observe erosion and sediment control measures identified in the Storm Water Pollution Prevention Plan to ensure that they are operating correctly. Inspect discharge locations or points to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Inspect locations where vehicles exit the site for evidence of offsite sediment tracking.

3.3.3 Erosion and Sediment Control Inspection Reports

Prepare "Storm Water Pollution Prevention Plan (SWPPP) Inspection Reports" (form provided at the pre-construction conference) to the Contracting Officer once every 7 calendar days and within 24 hours of a storm event that produced 0.5 inch or more of rain, and submit reports monthly. A copy of the inspection report shall be maintained on the job site.

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SECTION 01 78 00

CLOSEOUT SUBMITTALS

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 E 1971 (2005) Stewardship for the Cleaning of Commercial and Institutional Buildings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

As-Built Record of Equipment and Materials

Two copies of the record listing the as-built materials and equipment incorporated into the construction of the project.

Warranty Management Plan

One set of the warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. Furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

Final Cleaning

Two copies of the listing of completed final clean-up items.

Spare Parts Data

Two copies of list that ndicates manufacturer's name, part number, nomenclature, and stock level recommended for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

SD-08 Manufacturer's Instructions

Preventative Maintenance and Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

Define within the schedule 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. On each test feature; e.g., gpm, rpm, psi, provide a signoff blank for the Contractor and Contracting Officer. Within a remarks column of the testing validation procedure include references to operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventative maintenance, condition monitoring (predictive testing) and inspection, adjustment, lubrication and cleaning necessary to prevent failure.

Posted Instructions

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with paragraph entitled, "Operation and Maintenance," of this section.

SD-11 Closeout Submittals

Record Drawings

Drawings showing final as-built conditions of the project. The final CADD record drawings must consist of one set of electronic CADD drawing files in the specified format, 2 sets of blue-line prints of the mylars, and one set of the approved working record drawings.

1.3 PROJECT RECORD DOCUMENTS

1.3.1 Record Drawings

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 showning as-built conditions.

1.3.1.1 Working Record and Final Record Drawings

Revise 2 sets 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 Contracting Officer 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 Contracting Officer 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 Contracting Officer 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 Circle at the location of each deletion.

(3) For new details or sections which are added to a drawing, place a Modification Circle by the detail or section title.

(4) For minor changes, place a Modification Circle by the area changed on the drawing (each location).

(5) For major changes to a drawing, place a Modification Circle by the title of the affected plan, section, or detail at each location.

(6) For changes to schedules or drawings, place a Modification Circle either by the schedule heading or by the change in the schedule.

(7) The Modification Circle size shall be 1/2 inch diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.3.1.2 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 must be returned to the Contracting Officer 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.

1.3.2 As-Built Record of Equipment and Materials

Furnish one copy of preliminary record of equipment and materials used on the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Submit two sets of final record of equipment and materials 10 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

1.3.3 Final Approved Shop Drawings

Furnish final approved project shop drawings 30 days after transfer of the completed facility.

1.3.4 Construction Contract Specifications

Furnish final record (as-built) construction contract specifications, including modifications thereto, 30 days after transfer of the completed facility.

1.3.5 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 30 days after transfer of the completed facility.

1.4 SPARE PARTS DATA

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.

Supply two items of each part for spare parts inventory. Provision of spare parts does not relieve the Contractor of responsibilities listed under the contract guarantee provisions.

1.5 PREVENTATIVE MAINTENANCE

Submit Preventative Maintenance and Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

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 Contracting Officer 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.

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.

1.6 WARRANTY MANAGEMENT

1.6.1 Warranty Management Plan

Develop a warranty management plan which contains information relevant to the clause Warranty of Construction. At least 30 days before the planned pre-warranty conference, submit the warranty management plan for Government approval. Include within the warranty management plan all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan must be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below must include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase must be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Assemble approved information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period will begin on the date of project acceptance and continue for the full product warranty period. A joint 4 month and 9 month warranty inspection will be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. Include

within the warranty management plan , but not limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subContractors, manufacturers or suppliers involved.

b. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, valves, meters, pumps, motors, transformers, and for all commissioned systems such as alarm systems, lightning protection systems, etc.

c. A list for each warranted equipment, item, feature of construction or system indicating:

1. Name of item.
2. Model and serial numbers.
3. Location where installed.
4. Name and phone numbers of manufacturers or suppliers.
5. Names, addresses and telephone numbers of sources of spare parts.
6. Warranties and terms of warranty. Include one-year overall warranty of construction. Items which have extended warranties must be indicated with separate warranty expiration dates.
7. Cross-reference to warranty certificates as applicable.
8. Starting point and duration of warranty period.
9. Summary of maintenance procedures required to continue the warranty in force.
10. Cross-reference to specific pertinent Operation and Maintenance manuals.
11. Organization, names and phone numbers of persons to call for warranty service.
12. Typical response time and repair time expected for various warranted equipment.

d. The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

e. Procedure and status of tagging of all equipment covered by extended warranties.

f. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.6.2 Performance Bond

The Contractor's Performance Bond must remain effective throughout the construction period.

1.6.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty will be established/reviewed at this meeting. In connection with these

requirements and at the time of the Contractor's quality control completion inspection, furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, be continuously available, and sbe responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.6.4 Contractor's Response to Construction Warranty Service Requirements

Following oral or written notification by the Contracting Officer, respond to construction warranty service requirements in accordance with the "Construction Warranty Service Priority List" and the three categories of priorities listed below. Submit a report on any warranty item that has been repaired during the warranty period. Include within the report the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframes specified, the Government will perform the work and backcharge the construction warranty payment item established.

a. First Priority Code 1. Perform onsite inspection to evaluate situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.

b. Second Priority Code 2. Perform onsite inspection to evaluate situation, and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.

c. Third Priority Code 3. All other work to be initiated within 3 work days and work continuously to completion or relief.

d. The "Construction Warranty Service Priority List" is as follows:

Code 1-Air Conditioning Systems
(1) Recreational support.
(2) Air conditioning leak in part of building, if causing damage.
(3) Air conditioning system not cooling properly.

Code 1-Doors
(1) Overhead doors not operational, causing a security, fire, or safety problem.
(2) Interior, exterior personnel doors or hardware, not functioning properly, causing a security, fire, or safety problem.

Code 3-Doors
(1) Overhead doors not operational.
(2) Interior/exterior personnel doors or hardware not functioning properly.

Code 1-Electrical
(1) Power failure (entire area or any building operational after 1600 hours).
(2) Security lights
(3) Smoke detectors

Code 2-Electrical
(1) Power failure (no power to a room or part of building).

(2) Receptacle and lights (in a room or part of building).

Code 3-Electrical
Street lights.

Code 1-Gas
(1) Leaks and breaks.
(2) No gas to family housing unit or cantonment area.

Code 1-Heat
(1). Area power failure affecting heat.
(2). Heater in unit not working.

Code 2-Kitchen Equipment
(1) Dishwasher not operating properly.
(2) All other equipment hampering preparation of a meal.

Code 1-Plumbing
(1) Hot water heater failure.
(2) Leaking water supply pipes.

Code 2-Plumbing
(1) Flush valves not operating properly.
(2) Fixture drain, supply line to commode, or any water pipe leaking.
(3) Commode leaking at base.

Code 3 -Plumbing
Leaky faucets.

Code 3-Interior
(1) Floors damaged.
(2) Paint chipping or peeling.
(3) Casework.

Code 1-Roof Leaks
Temporary repairs will be made where major damage to property is occurring.

Code 2-Roof Leaks
Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.

Code 2-Water (Exterior)
No water to facility.

Code 2-Water (Hot)
No hot water in portion of building listed.

Code 3-All other work not listed above.

1.6.5 Warranty Tags

At the time of installation, tag each warranted item with a durable, oil and water resistant tag approved by the Contracting Officer. Attached each tag with a copper wire and spray with a silicone waterproof coating. The date of acceptance and the QC signature must remain blank until the project is accepted for beneficial occupancy. Show the following information on the tag.

a. Type of product/material_____.

b. Model number_____.

c. Serial number_____.

d. Contract number_____.

e. Warranty period_____from_____to_____.

f. Inspector's signature_____.

g. Construction Contractor_____.

Address_____.

Telephone number_____.

h. Warranty contact_____.

Address_____.

Telephone number_____.

i. Warranty response time priority code_____.

j. WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.

1.7 OPERATION AND MAINTENANCE MANUALS

Operation and Maintenance Manuals must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Bind information in manual format and grouped by technical sections. Test data must be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals must have 0.3937-inch holes and be bound in 3-ring, loose-leaf binders. Organize data by separate index and tabbed sheets, in a loose-leaf binder. Binder must lie flat with printed sheets that are easy to read. Caution and warning indications must be clearly labeled.

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. Contracting Officer will be given 7 calendar 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 Contracting Officer.

Submit 6 copies of the project operation and maintenance manuals 30 calendar days prior to testing the system involved. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

1.8 CLEANUP

Provide final cleaning in accordance with ASTM E 1971. 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. 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

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 E 1971	(2005) Stewardship for the Cleaning of Commercial and Institutional Buildings

1.2 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit 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.

1.2.1 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.2.2 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 3. Commissioned items with a Data Package 1 or 2 requirement shall use instead Data Package 3.

1.2.3 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 Contracting Officer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.2.4 Review and Approval

The Government's Commissioning Authority (CA) 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.

1.2.5 O&M Database

Develop a database from the O&M manuals that contains the information required to start a preventative maintenance program.

1.3 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.3.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.3.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.3.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.3.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.3.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.3.1.5 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.

1.3.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as

lubrication, adjustment, inspection, and recording gage readings.

1.3.1.7 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.

1.3.2 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.

1.3.2.1 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.

1.3.2.2 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.

1.3.2.3 Cleaning Recommendations

Provide environmentally preferable cleaning recommendations in accordance with ASTM E 1971.

1.3.3 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.

1.3.3.1 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.

1.3.3.2 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.

1.3.3.3 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.

1.3.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list of 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.

1.3.3.5 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.

1.3.4 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.

1.3.5 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:

1.3.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.3.5.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

1.3.5.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.3.5.4 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

1.3.5.5 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.

1.3.5.6 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.

1.3.5.7 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.

1.3.5.8 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

1.3.5.9 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.

1.4 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 print out of all schedules and set points after testing and acceptance of the system.

e. Full as-built print out of software program.

f. Electronic copy on disk or CD of the entire 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.

1.5 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:

1.5.1 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)

-- End of Section --

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SECTION 02 41 00

DEMOLITION AND DECONSTRUCTION

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.

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI Guideline K	(2005) Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6	(2006) Safety Requirements for Demolition Operations

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(Rev K; Change 1) Obstruction Marking and Lighting

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

1.2 GENERAL REQUIREMENTS

Do not begin demolition or deconstruction until authorization is received from the Contracting Officer. 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; do not allow accumulations inside or outside the buildings. The work includes demolition, deconstruction, 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 Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with OSHA, NASA/KSC Health and Safety Policies, and other applicable Sections.

1.3 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-01 Preconstruction Submittals

Existing Conditions; G
Demolition Plan; G
Notifications; G

Proposed salvage, demolition, deconstruction, and removal procedures for approval before work is started.

SD-07 Certificates

Certification of DBPR certified pollutant storage contractor; G

1.4 REGULATORY AND SAFETY REQUIREMENTS

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.

1.4.1 Notifications

1.4.1.1 General Requirements

Furnish timely notification of demolition and deconstruction projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the State's environmental protection agency and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M.

1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris 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.

Contractor shall use best management control measures to prevent the release of paint chips to the environment.

Best management practices include, but are not limited to, the following:

a. Contractor shall contain demolition debris where possible to impermeable surfaces.

b. Contractor shall control stormwater runoff from the site with silt fencing.

c. Contractor shall conduct daily housekeeping to limit potential paint chip migration.

d. Contractor shall collect and remove all demolition debris from the project area.

e. Sediment collected adjacent to silt fence shall be containerized and disposed of appropriately.

f. Upon completion of demolition, the first 6 inches of top soil shall be removed from within and 6 feet beyond the project area and disposed of

in the KSC landfill.

1.6 PROTECTION

1.6.1 Traffic Control Signs

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 Contracting Officer prior to beginning such work.

Contractor must 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 Contracting Officer. Maintain the temporary services during the period of construction and remove only after permanent services have been installed and tested and are in operation.

1.6.2 Existing Conditions Documentation

Before beginning any demolition or deconstruction 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 Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Digital 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.

1.6.3 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 Contracting Officer. 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, deconstruction, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

1.6.4 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.

1.6.5 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 areas.

1.6.6 Trees

Protect trees within the project site which might be damaged during demolition or deconstruction, and which are indicated to be left in place, by a 6 foot high fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

1.6.7 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction 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.

1.6.8 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 Contracting Officer. 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, deconstruction, or demolition work performed under this contract.

1.6.9 Protection of Personnel

Before, during and after the demolition and deconstruction work the Contractor shall continuously evaluate the condition of the structure being demolished and deconstructed 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.

1.7 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Items to be relocated which are damaged by the Contractor shall be repaired or replaced with new undamaged items as approved by the Contracting Officer.

1.9 REQUIRED DATA

Prepare a Demolition Plan. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, and a disconnection schedule of utility services, 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. Submit certification of DBPR certified pollutant storage contractor for removal of underground storage tank. Provide procedures for safe conduct of the work in accordance with Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS. Plan shall be approved by Contracting Officer prior to work beginning.

1.10 ENVIRONMENTAL PROTECTION

Comply with the Environmental Protection Agency and NASA/KSC requirements specified.

Best Management Practices (BMPs) must be used to prevent releases of metal and/or PCB contaminated paint chips to the environment. The following are offered as suggested BMPs:

1. Where possible, demolish structures by collapsing walls inward onto facility foundation.

2. Where possible, limit heavy equipment use to paved surfaces.

3. Control stormwater runoff from paved areas by installing silt fencing and/or sediment barriers across stormwater flumes.

4. Drum or containerize, using appropriate PWQ/TRP listed containers, all paint chip contaminated sediments and submit debris for testing. Dispose of characterized sediment waste in accordance with KSC Waste Management Requirements following the PWQ/TRP process.

5. Maintain regular housekeeping on the construction site thus preventing significant stormwater runoff before it occurs.

1.11 USE OF EXPLOSIVES

Use of explosives will not be permitted.

PART 2 PRODUCTS

2.1 FILL MATERIAL

Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill basements, voids, depressions or excavations resulting from demolition or deconstruction of all structures both above and below grade. Fill material shall be waste products from demolition or deconstruction until all waste appropriate for this purpose is consumed.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures on site 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 on site whenever possible.

3.1.1 Structures

a. Remove existing structures indicated to bottom of foundation walls. Interior walls, other than retaining walls and partitions, shall be removed below grade or to top of concrete slab on ground as specified in the contract documents. 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 Contracting Officer.

c. Locate demolition and deconstruction equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

d. Building, or the remaining portions thereof, not exceeding 80 feet in height may be demolished by the mechanical method of demolition.

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 Contracting Officer. 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 deconstruction 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 Contracting Officer. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer.

3.1.3 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs including aggregate base 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 Contracting Officer. Unpainted concrete shall be transported to DARCY in accordance with the contract clause "Landfill Operations/Solid Waste Removal".

3.1.4 Concrete

Salvage removed concrete.

3.1.5 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for reuse or recycle structural steel, steel joists, girders, angles, plates, columns and shapes. Flame-cutting torches are permitted when other methods of dismantling are not practical. Where possible, hot work on painted/coated metal structures should be avoided. If hot work is necessary, affected paint/coating must be sampled for PCBs to determine if additional respiratory protection is required. Degradation of PCBs occur under moderate/extreme thermal conditions (such as torch work) causing PCB materials to degrade into dioxins and other by-product chemicals. The Contractor shall consult with its Industrial Hygiene representative prior to conducting hot work on any painted/coated surfaces.

3.1.6 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 deconstruction 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.

3.1.7 Carpentry

Salvage for reuse or recycle lumber, millwork items, and finished boards, and sort by type and size. Chip or shred and recycle salvaged wood unfit for reuse, except stained, painted, or treated wood.

3.1.8 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)."

3.1.9 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Mechanical equipment and fixtures must be disconnected at fittings. Remove service valves attached to the unit. Where indicated, 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 Contracting Officer. Do not remove equipment until approved. Do not offer low-efficiency equipment for reuse; provide to recycling service for disassembly and recycling of parts.

3.1.9.1 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, must be steam cleaned. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit.

3.1.9.2 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. 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.

3.1.9.3 Fixtures, Motors and Machines

Drain oil and grease on motors and machines in accordance with Section 02 84 33 REMOVAL AND DISPOSAL OF POLYCHLORINATED BIPHENYLS (PCBs). Where indicated, 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 and disposed of by the Contractor.

3.1.10 Electrical Equipment and Fixtures

Where indicated, 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.

3.1.10.1 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. Note: Ballasts that cannot be identified as being PCB-free shall be managed as if they are PCB-contaminated.

3.1.10.2 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.

3.1.10.3 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.

3.1.10.4 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.

3.1.11 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 deconstruction work in areas occupied by structures to be demolished or deconstructed until all demolition and deconstruction 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 deconstruction, and materials and equipment to be

removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Contracting Officer to begin demolition and deconstruction. 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 Export Control

The Contractor shall comply with U.S. Export Control Laws. All facilities and associated equipment shall be deconstructed so that they can neither be reassembled nor recognized. The Contractor shall render unrecognizable all NASA and Contractor tags.

3.3.3 Reuse of Materials and Equipment

Remove and store materials and equipment listed in the Demolition Plan or as indicated by the Contracting Officer to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.3.4 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 the Reutilization, Recycling and Marketing Facility (RRMF).

a. Salvage items and material to the maximum extent possible.

b. Store all materials salvaged for the Contractor as approved by the Contracting Officer and remove from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

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.

d. Remove historical items in a manner to prevent damage.

e. Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990.

3.3.5 Recycling

The Contractor must make every practical effort to reclaim and segregate materials that have the ability to be recycled. All reclaimed concrete must be segregated from other wastes and transported to the KSC Landfill (L7-0071) on Schwartz Road. All unpainted concrete must be transported to the Diverted Aggregate Reclamation and Collection Yard (DARCY). All reclaimed scrap metal, not being recycled by Contractor outside KSC, must be transported to the Reutilization, Recycling and Marketing Facility (RRMF) with a KSC Form 7-49. Please turn these items and the KSC Form 7-49 into RRMF personnel to ensure the proper disposition of the materials prior to leaving the recycling area. For any other information regarding what materials can be recycled or other general information regarding recycling

policies at KSC, please contact NASA Environmental.

3.3.6 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 ARI 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 Contracting Officer. 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.

3.3.6.1 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 the contract clause "Hazardous Waste". 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 shipment

3.3.6.2 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.

3.3.7 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material in the KSC Class III landfill located on Schwartz Road in accordance with Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION.

3.4 CLEANUP

Remove debris and rubbish from excavations. Remove and transport them 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 in the Waste Management Plan and Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION. Storage of removed materials on the project site is prohibited, unless otherwise specified on the drawings.

3.5.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted on Government property.

3.5.3 Removal to Spoil Areas on Government Property

Transport noncombustible materials removed from demolition and deconstruction structures to designated spoil areas on Government property.

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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ASBESTOS ABATEMENT

PART 1 GENERAL

1.1 SUMMARY

This section specifies the asbestos abatement requirements and the Contractor's applicable asbestos procedures, which include demolition or salvage of structures where asbestos is present, removal or encapsulation of materials containing asbestos, construction, alteration, repair, maintenance, or renovation of structures, substrates, or portions thereof, that contain asbestos, installation of products containing asbestos, asbestos spill/emergency cleanup, transportation, disposal, storage, containment of and housekeeping activities involving asbestos or products containing asbestos, on the site or location at which construction activities are performed.

Under OSHA, Asbestos Abatement work is categorized into four classes:

Class I Work: Activities involving the removal of Thermal System Insulation (TSI) and surfacing Asbestos Containing Materials (ACM) and Presumed Asbestos Containing Material (PACM).

Class II Work: Activities involving the removal of ACM that is not TSI or surfacing material. This includes wallboard, floor tile and sheeting, roofing, siding, shingles, and construction mastics.

Class III Work: Repair and Maintenance operations, where ACM, including TSI and surfacing ACM and PACM, is likely to be disturbed.

Class IV Work: Maintenance and custodial activities during which employees contact but do not disturb ACM or PACM and activities to clean up dust, waste, and debris from Class I,II, and III activities.

Conduct abatement work in accordance with the Class I, II, III, or IV Methods of Compliance as required by 29 CFR 1910,29 CFR 1926, 40 CFR 61-SUBPART M, 49 CFR 171, 49 CFR 172, FAC CHAPTER 62-257, and FL-STAT 469. Submit all required training certifications prior to commencement of work.

1.2 DEFINITIONS

FLAC - Florida Licensed Asbestos Consultant as defined within the FL-STAT 469 ASBESTOS ABATEMENT.

IH - Kennedy Space Center Industrial Hygienist. This person can be either a Government Civil Servant or an authorized Government Contractor. This person is responsible for the oversight, approval of the abatement procedures and the health, safety, and welfare of those who it effects.

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.

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-7.1	(2004) Commodity Specification for Air

FLORIDA ADMINISTRATIVE CODE (FAC)

FAC CHAPTER 62-257	Florida Administrative Code, Asbestos Program

FLORIDA STATUTES (FL-STAT)

FL-STAT 469	Asbestos Abatement

JOHN F. KENNEDY SPACE CENTER (KSC)

KNPR 8500.1	KSC Environmental Requirements
KNPR 1840.19	KSC Industrial Hygiene Programs
KNPR 8715.3	KSC Safety Practices Procedural Requirements

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 7400	(1994) Standard Test Method for Asbestos and Other Fibers by PCM
NIOSH 94-113	(1994; 4th Ed) NIOSH Manual of Analytical Methods

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
40 CFR 61-SUBPART M	National Emission Standard for Asbestos
40 CFR 763	Asbestos
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

1.4 DESCRIPTION OF WORK

Abate materials containing asbestos as indicated on the drawings in accordance with the contract clause "Asbestos Abatement."

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Work Schedule; G in accordance with the paragraph entitled, "Worker Protection," of this section.

Notification of Demolition/Renovation; G

SD-02 Shop Drawings

Submit items in accordance with the paragraph entitled, "Implementation Plan," of this section.

Coordination Drawings; G

Detailed Drawings

SD-06 Test Reports

Submit the following:

Initial Exposure Assessments in accordance with 29 CFR 1926

Submit Air Monitoring Reports in accordance with paragraph entitled, "Air Monitoring Report," of this section.

Maintain Work Site entry logs of all personnel entering and leaving the regulated work area by the on-site competent person indicating the date and time of entry and egress.

Maintain Daily Site Inspection Logs by the on-site competent person indicating the date, time and results of the work area daily site inspections.

Maintain Waste Inventory of all generated waste drums or containers indicating the location and approximate quantity of material in each container.

SD-07 Certificates

Submit the following certificates:

Asbestos Consultant's License from the State of Florida, Department of Business and Professional Regulation (DBPR)

Asbestos Contractor's License; G or other Contractor license approval from the State of Florida, Department of Business and Professional Regulation (DBPR).

Training Certifications; G, and experience of Contractor's "Competent Person", Supervisor, and workers.

Proficiency Analytical Test Certification

SD-08 Manufacturer's Instructions

Submit Material Safety Data Sheets in accordance with the paragraph entitled, "Licenses Permits, and Notices," of this section.

Submit Implementation Plan; G as identified in paragraph entitled, "Implementation Plan," prior to initial site set-ups or start of work.

SD-11 Closeout Submittals

Within 10 days after the completion of work, submit to the Contracts Administrator a written summary and copies of the following items:

Notification of Demolition/Renovation.

Waste Disposal Permit and all Disposal Shipping Manifests and Tickets.

Daily site inspection logs, negative pressure logs and other OSHA compliance inspection records.

Air Monitoring Reports conducted during the abatement.

Calibration Records; G for sampling equipment taken before and after each air sample.

Entry logs and Waste Stream Inventory maintained during the abatement task.

1.6 LICENSES PERMITS, AND NOTICES

Ensure that the FLAC possesses a current license and comply with all Federal, State and Local Regulations. Only those consultants who are certified and licensed by DBPR are permitted to perform Asbestos Surveys or abatement specifications and plans as per Florida Statute 469.

Contractor's possession of a current Asbestos Contractor's License is mandatory, as well as securing all necessary licenses and permits associated with asbestos removal, transportation, and disposal as may be required by Federal, State, and local regulations. Only those Contractors who are certified and licensed by the State of Florida will be permitted to perform asbestos abatement activities at Kennedy Space Center.

A Waste Disposal Permit and all Disposal Shipping Manifests and Tickets are to be obtained.

Submit the following certificates:

Certification of participation in a Proficiency Analytical Test (PAT) program such as or equivalent to the American Industrial Hygiene Association PAT or Asbestos Analytical Registry (AAR) accreditation certificate and Interlab QA/QC Program participation for the independent air monitoring agency selected by the Contractor before starting work.

Training Certifications and accreditation certificates for the independent air monitoring agency's on-site personnel and a copy of independent air monitoring agency's Quality Control Program.

Certification documents by the Contractor verifying that employees have been provided current respirator fit test, training, and medical examinations in compliance with 29 CFR 1926.

Material safety data sheets as required for materials to be used on the specified project.

1.6.1 Notification

When applicable, submit Florida Department of Environmental Protection (DEP) "Notice of Demolition or Asbestos Renovation" (DEP Form 62-257.900(1)) to DEP District Office. A copy of the notification is to be provided to the Government as part of the Implementation Plan.

1.7 IMPLEMENTATION PLAN

Prepare and submit a detailed, written Implementation Plan created, signed and sealed by a FLAC to the Government for approval, prior to the start of work, that includes the following:

Coordination drawings including site specific drawings of proposed work areas, clean room/change areas, mini-enclosures, shower, equipment room, waste loading/staging areas, locations of High Efficiency Particulate Air (HEPA) filtered negative pressure devices and exhaust points, work areas, emergency egress, and areas to be modified.

Detailed drawings for asbestos abatement systems 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.

A copy of the applicable DEP Notification of Demolition/Renovation (DEP Form 62-257.900(1)).

Plan of Action, including proposed procedures to be used in complying with the requirements of this specification, 29 CFR 1926,and other applicable regulatory requirements, sequence of asbestos abatement work, the interfaces of trades involved in the performance of work, posting of licenses, permits, etc., methods to be used to assure the safety of building occupants and visitors to the site, disposal plan including location of approved disposal site, a detailed description of the methods employed to control pollution, and a detailed work schedule. Expand upon the method for removal of ACM, the use of portable HEPA ventilation systems, closing out of the buildings HVAC system, method of removal to prohibit visible emissions in the work area, and packaging of removed debris.

Details of the decontamination areas and procedures, locations of staging areas, posting of warning signs, and details of negative air system to be used in the work area.

Sketch(s) or drawing(s) of complete contract area(s) showing the shower room, clean room, drum staging area, decontamination and containment areas, the negative air system, and exits. Indicate designation of the "Competent

Person" (CP), and Site Supervisor.

Provide a written Air Monitoring Plan to be prepared under the direction of and signed/stamped by a Certified Industrial Hygienist (C.I.H.)or FLAC specifying the air monitoring criteria and an action plan for implementation by the Competent Person. Identify in the plan the Competent Person to be on site at all times (unless otherwise authorized by the Contracts Administrator) during asbestos abatement operations. The FLAC or his/her representative/competent person is responsible for ensuring applicable regulatory compliance during all phases of the asbestos abatement activities. The competent person has the authority to stop work for unsafe conditions and for not adhering to applicable regulations. Provide a qualified back-up person in the event that the Competent Person is absent from job site.

Provide certification that the Contractor, his staff, and abatement workers (including Supervisors) have attended and successfully completed (an) asbestos abatement course(s) including refresher courses as set forth in FL-STAT 469 and in accordance with 29 CFR 1926 and 40 CFR 763.

Provide a Respiratory Protection Program in accordance with 29 CFR 1910 including training in the care, use, and maintenance of respirators and fit test certification.

Provide a written description of respiratory equipment (name, type, model number) and protective clothing provided to the abatement workers.

Provide documentation that all personnel assigned to the abatement project have been examined annually by a physician. Submit the physician's written opinion containing the results of the employee's medical examination in compliance with 29 CFR 1926. Establish, maintain, and make readily available for review all Work site entry logs.

Provide Procedures for enforcement of Personal Hygiene Practices.

Prepare and submit a Contingency Plan for emergencies including fire, accident, power failure, heating or cooling, negative air system failure, respirator supplied air system failure, or any other event that may require modification of the work area isolation procedures. Include in the plan specific procedures for decontamination or work area isolation, safe exiting, and the need for medical attention in the event of an emergency.

Submit any additional procedures (fall protection, confined space, etc.) and policies that are in effect to ensure worker safety and environmental, KNPR 8500.1 and KNPR 8715.3) requirements are met.

Submit the Implementation Plan to the Government for review and approval. Commencement of work will not be permitted until the Implementation Plan is given final approval.

1.8 AIR MONITORING REPORTS

Obtain the services of an independent Air Monitoring Agency accredited by the American Industrial Hygiene Association (AIHA), for analysis of airborne asbestos concentration levels. Provide a copy of the monitoring agency's Quality Control Program to Contracts Administrator prior to commencement of the abatement activities. Ensure the individual performing the on-site air monitoring meets the requirements as set forth in FL-STAT 469 and 40 CFR 763, and performs sample collections in accordance

with the approved Air Monitoring Plan.

Perform all Air Monitoring under the direction of the FLAC using an independent Air Monitoring Contractor, in compliance with Florida Statute 469 requirements.

Calibrate pumps before and after each air sample and submit calibration records to the Government.

Submit daily Air Monitoring Reports. Include in the Air Monitoring Report the following information for each sample:

Sample identification, Sample location,

Employee Name, Social Security Number,

Description of task being monitored,

Exposure level results in (f/cc),

Monitoring instrument identification number,

Pre-calibration, post calibration, and average flow rate of each sample,

Sample date, start and stop times,

Type of protective devices worn (if any),

Project identification number, Facility number and name,

Sampling and Analytical Methods used,

Contact name and company, and name of individual performing the sampling.

1.8.1 Air Sample Analytical Method

Airborne fiber sampling and analytical procedures are to be analyzed by Phase Contrast Microscopy (PCM) in accordance with 29 CFR 1926 and NIOSH 94-113 7400 method.

1.8.2 Air Sampling Rate, Volumes and Frequency

Conduct daily monitoring utilizing sample rates, volumes and frequency in accordance with 29 CFR 1926 and retain for final submittal at closeout. The minimum number of samples or sample volumes may not be less than those specified below:

Type of Sample	Volume	Minimum No. Samples	Location
Prior to set-up (within 24 hrs)	1200L	2	Regulated Area
Personal, During work	400L	2	Personal B.Z.
Area samples, Adjacent to work area.	1200L	2	Regulated Area
Area samples at Negative	1200L	1	In area of outlets

Type of Sample	Volume	Minimum No. Samples	Location
Air Unit Exhaust.			

NOTE: The KSC IH will perform air sampling outside the regulated work area.

1.9 WORKER PROTECTION

Perform Initial Exposure Assessments and Employee Exposure Monitoring in accordance with 29 CFR 1926, part 1926.1101, with input and approval of the FLAC.

Select and provide respiratory protection to employees and ensure they are utilized in accordance with 29 CFR 1926.

Submit the Work schedule indicating the work days, hours, and the number of workers per shift. Include a bar chart to identify the individual milestones through to the completion of the project (i.e., number of days to complete work site preparation, number of days to complete ACM removal, number of days to complete final cleaning and lockdown, etc.).

Submit the OSHA compliance inspection records as part of the closeout documents.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 TEMPORARY UTILITIES AND SERVICES

The Government will make available at the work site, water at hose bibs and 120 Volt AC at receptacles for the Contractor's use. Provide water proof safety lighting where necessary for safe, adequate illumination.

Ensure all electrical equipment to be used inside the work areas is powered from an Underwriters Laboratory (UL) approved Ground Fault Circuit Interrupter (GFCI). Do not exceed the manufacturers limits per GFCI. Make all necessary connections and restore the site connections to their original condition or better, prior to project completion.

Ensure all energized or pressurized systems inside the work area have been locked out, tagged out or otherwise rendered safe.

Provide temporary water from the existing building water source to control the generation of airborne dust, to allow for area, personnel, and equipment decontamination, and to supply decontamination unit needs. Also provide a backflow preventer at the source.

Provide temporary sanitary drainage piping to the decontamination unit sump and to the shower unit at a minimum slope of 2.0 percent, and temporary drainage piping to waste water pump and existing drain in accordance with local standards and as approved by the Contracts Administrator. Collect used shower water and filter with approved water filtration equipment to remove asbestos contamination. Discharge only clean water to the sanitary system.

3.2 WORK AREA PREPARATION

The Government will re-arrange equipment and storage areas to the extent of providing a direct and unobstructed path to the work area(s). During ACM removal, confine equipment and employees to the designated work area(s).

Unless otherwise directed by the Contracts Administrator, the Contractor is to establish and maintain a 25-foot access control barrier zone(s) around the designated work area(s). Interference with the functional operation of the building occupants outside these areas is not permitted.

Ensure all building supply and return air ducts from the mechanical system are isolated to eliminate air flow into or out of containment area(s).

3.2.1 Pre-Cleaning

Shut down HVAC systems and seal all critical barriers prior to initiating pre-cleaning actions. Seal, with 6 mil minimum thickness plastic sheeting, all openings, including but not limited to, windows, corridors, doorways, elevator openings, skylights, ducts, grilles, diffusers, and any other penetrations between the contaminated work areas and uncontaminated areas.

Pre-clean all movable objects identified as contaminated by the Contracts Administrator or his/her representative within the work area using a HEPA filtered vacuum and wet cleaning methods as appropriate. Remove these objects after cleaning and store in a protected area.

Pre-clean all surfaces in the work area using HEPA filtered vacuums and/or wet cleaning methods as appropriate. Methods that would raise dust, such as dry sweeping or vacuuming with equipment not equipped with HEPA filters, are PROHIBITED. Pay detailed attention to machinery or areas behind grilles and gratings.

Do not remove or otherwise disturb asbestos containing building materials during the pre-cleaning phase.

3.2.2 Work Area(s)

Inform all other Contractors and personnel on the site of the abatement work of the nature of the Contractor's work with ACM and/or PACM, of the existence of and requirements pertaining to regulated areas, and the measures taken to ensure that employees of such other Contractor employers are not exposed to asbestos in accordance with 29 CFR 1926.

Use industry controls and work practice methods in accordance with 29 CFR 1926. Ensure daily site inspection logs are posted at the jobsite by the on-site competent person.

Use flame resistant, 6 mil polyethylene sheeting when constructing Negative Pressure Enclosures (NPE) or decontamination areas.

3.3 WASTE LOAD-OUT UNIT

Establish a waste load-out unit to provide for interim secure storage. Include an equipment room for storage of asbestos-contaminated items (drums, tools, equipment). Decontaminate all equipment and waste containers prior to being taken out of the work area(s).

All asbestos-containing waste material is to be sealed in leak-tight

disposal containers or bags. Thoroughly wet all waste within the disposal containers. Maintain proper labeling protocols for all running and final inventory of filled disposable containers.

3.4 SIGNS AND MARKINGS

Post signs prior to commencing asbestos work as required in 29 CFR 1926. Post signs at the perimeter of the asbestos work areas, along the route of the temporary waste material holding (Drum Staging) area, and at all entrances to asbestos work areas. Ensure signs are conspicuous and legible.

Post telephone numbers and locations of emergency services including, but not limited to, fire, ambulance, doctor, and hospital, at the regulated area.

Post one copy of all permits at the work site perimeter in a accessible location outside the regulated area.

Post one copy of the Abatement Contractors current license at the work site perimeter in a accessible location outside the regulated area.

Post hazard communication notification signs in accordance with KNPR 1840.19 requirements.

3.5 NEGATIVE AIR SYSTEM

Construct Negative Pressure Enclosures (NPE's) as required by 29 CFR 1926.

Duct each of the negative air units through the containment barrier walls to the outside of the work area(s). When the building is occupied, ensure that the ducts exhaust into the outside air; otherwise, they may exhaust into an area of the building beyond the critical barriers. Never exhaust the units into the work area(s).

Provide each unit with temporary back-up electrical power (120 Volt AC) in the event of power failures or outages.

3.5.1 Testing

Design the negative air system to provide a minimum of four (4) air changes per hour and test before any work is begun. After the work area has been prepared, the decontamination unit set up, and the negative air units(s) installed, test the system. Prior to beginning abatement activities, an Asbestos Abatement Pre-Work Inspection checklist (KSC Form 28-1230NS) will be completed by the KSC IH to verify the adequacy of the containment system and work area. Once activated, ensure the negative air exhaust unit(s) remain in operation until final clearance air monitoring has been performed and the KSC IH has approved their shutdown/removal. Maintain daily negative pressure logs for review by the FLAC.

Install a differential pressure meter or manometer to continuously measure pressure differential between inside and outside the work area for all Class I activities which utilize a NPE. Maintain a minimum pressure differential of 0.02 inch of water column.

3.6 RESPIRATORY PROTECTION

Instruct and train each worker involved in asbestos abatement in proper respirator use and care. Fit all respirators by approved qualitative or

quantitative test. Use respiratory protection appropriate for the fiber level encountered in the Work Area and as specified herein, or as required for other situations encountered.

3.6.1 Air Quality for Supplied Air Respiratory Systems

The Contractor is to provide air used for breathing in Type "C" supplied air respiratory systems that meets or exceeds CGA G-7.1, standards for Grade D air.

3.7 REMOVAL OF ASBESTOS

Use industry controls and work practices for all operations in accordance with 29 CFR 1926 Methods of Compliance for Class I, II, III, or IV asbestos work. The FLAC or his/her representative are responsible for these practices.

Ensure all Class I, II, III and IV work is supervised by an on site Competent Person at all times that work is in progress.

Following removal of contaminated items and asbestos material, seal the edges of adjacent surfaces, which were exposed when asbestos was removed, with an asbestos bridging sealant/encapsulant.

3.8 DAILY HOUSEKEEPING

Maintain a clean work area in accordance with 29 CFR 1926. Perform the following housekeeping functions at the end of each shift or prior to leaving the work site unattended:

a. Prepare contaminated waste for disposal by packaging the waste and removing it from the work area.

b. HEPA vacuum the work area.

c. Visually inspect polyethylene in the work area and other high traffic areas.

3.9 CLEANING PROCEDURES

Clean the work area at the end of each day's abatement activities. Designate a separate, secured area within the work area for storage of debris until it can be properly disposed. Secure the work area after termination of the work day to prevent entry. Regularly dispose and replace disposable supplies, such as mop heads, sponges, and rags. Clean all equipment by HEPA vacuuming and wet wiping.

Clean all work areas in which abatement operations have been completed, starting at the ceiling and working down to the floors, by HEPA vacuuming and wet wiping. Prior to removal of worksite access controls and re-occupancy inspection by the Government, and upon satisfactory final clearance air sampling, and removal of polyethylene sheeting, perform a final cleaning (wet wipe) of all surfaces within the work area.

3.10 INSPECTION

Do not commence removal of asbestos materials prior to satisfactory KSC IH, concurrence to proceed on the Asbestos Abatement Pre-Work Inspection (checklist KSC Form 28-1230NS).

3.10.1 Initial Inspection

The Contractor and the KSC IH will conduct a walk-through of the work area prior to beginning the abatement work to review existing conditions and ensure safe and practical conditions for the work to be implemented. Any damage to structures, surfaces, and equipment, which could be misconstrued as damage resulting from work, is to be documented by the Contractor and immediately submitted to the Contracts Administrator.

Perform background sampling for work areas in accordance with 29 CFR 1926 prior to beginning the abatement work.

3.10.2 Daily Inspection

Maintain a work site entry log of all personnel who enter the regulated work area. Through continuous surveillance and inspections of the worksite, ensure the integrity of containment, proper function of the negative pressure system, and posting of signs and labels. Also ensure, through frequent inspections during each work shift, that negative pressure is maintained, appropriate work practices are followed, appropriate protective clothing and equipment are used, and worker decontamination procedures are being followed.

Ensure that critical barriers and negative pressure enclosures remain effectively sealed and taped. Take immediate action to remedy defects immediately upon discovery. Details of the inspections are to be included in the Contractor's daily inspection log and posted in an accessible location outside the regulated area.

Provide updated copies of the Air Monitoring Reports, Daily Site Inspection Logs and Waste Stream Inventory to the Contracts Administrator at the end of each week of the abatement work.

NASA/Kennedy Space Center reserves the right to conduct periodic inspections and air monitoring in the work area(s). If the work area is unsafe as determined by the Contracts Administrator for KSC IH, the Contracts Administrator, will require the Contractor to stop work until the unsafe conditions are corrected.

3.10.3 Final Inspection

The thoroughness of asbestos removal is to be evaluated by visually inspecting the affected surfaces for residual asbestos material and accumulated dust followed by air sampling. Evidence of residual asbestos or asbestos debris on any adjacent surfaces upon completion of the work is not acceptable.

Upon completion of the work, conduct a thorough visual inspection of the work area by the Abatement Contractor and by the KSC IH to ensure no residual asbestos material, dust or debris remains. Document final inspections on the Asbestos Abatement Clearance Inspection Checklist (KSC Form 28-1231NS), which will be completed by KSC IH.

If applicable, final aggressive air sampling is to be performed by the KSC IH for each NPE work area after completion of a satisfactory visual inspection. The clearance criteria is 0.01 fibers per cubic centimeter (f/cc) of air as determined by PCM. Satisfactory fiber counts from all final samples are to be less than 0.01 f/cc. If any of the final air

samples contain greater than 0.01 f/cc, repeat the final cleaning operation and re-test the area until satisfactory clearance levels are obtained.

Collect five (5) PCM final air samples for the first 5,000 square feet of containment plus one (1) additional PCM final air sample for each additional 5,000 square feet or one (1) air sample per room, whichever is greater. The number of final air samples may be reduced for small enclosures of less than approximately 2500 square feet. In no case may fewer than two (2) final samples be collected for any enclosure.

Ensure clearance air sample volumes meet the minimum volumes as indicated for analysis by NIOSH 7400 method.

3.11 ASBESTOS WASTE AND CONTAMINATED MATERIALS

3.11.1 Removal of Asbestos Waste Materials

For purposes of this paragraph, asbestos waste materials are defined as those materials which contain or have been contaminated by asbestos and are not planned to be encapsulated and remain at the job site. They are primarily removed asbestos, disposable clothing and safety equipment, polyethylene sheeting, contaminated amended water, vacuum cleaner contents, and filtration media.

Contain all asbestos waste material in two (2) 6 mil polyethylene disposal bags, or two (2) 6 mil disposal bags and a sealed leak-tight container such as, but not limited to, a steel or fiberboard drum. Pack the asbestos waste material while still wet. Clean the external surface of the waste containers by HEPA vacuuming and wet wiping before moving from the work area. Protect the interior of truck or dumpster with two layers of polyethylene sheeting.

3.11.1.1 Waste Inventory

Label and clearly mark all disposal containers, dumpsters, and trucks, in accordance with 40 CFR 61-SUBPART M, 29 CFR 1910 of OSHA's Hazard Communications Standard, and 49 CFR 171 and 49 CFR 172, Hazardous Substances.

Provide conspicuous, legible labels, affixed to plastic bags and drums indicating the name of the waste generator and the location (facility name and number) where the waste was generated.

For non-friable asbestos that will be disposed at the KSC/Schwartz Road Landfill, provide a completed landfill disposal verification form (KSC Form 28-1064NS) send to Contracts Administration. NOTE: Regulated ACM is not permitted for disposal at KSC/Schwartz Road Landfill.

Provide a Waste Shipment Record (WSR) to the Contracting Officer in accordance with the instructions in 40 CFR 61-SUBPART M.

3.11.2 Work Area Disposal

After final inspection has been completed and the work area is released for occupancy, shut off and remove the Negative Air System units. Unseal all entrances and exits. Dispose of all plastic sheeting, tape, and any other trash and debris, except for critical barriers, in sealable plastic bags, or in drums and moved to the staging area. After final wet wipe of the work area and satisfactory clearance air sampling, dismantle critical

barriers and the decontamination unit.

3.11.3 Decontamination Area And Support Area Disposal

Dismantle the decontamination area after the work area is released by the KSC IH for re-occupancy. Vacuum all surfaces of the decontamination unit before it is disassembled.

3.12 WASTE TRANSPORTATION AND DISPOSAL

Transport and dispose of asbestos waste in full compliance with 40 CFR 61-SUBPART M, SUBPART A, 49 CFR 171 and 49 CFR 172.

3.13 ASBESTOS ABATEMENT NOTICE AND CHECKLIST

An Asbestos Abatement Pre-Work Inspection form (KSC Form 28-1230NS) and an Asbestos Abatement Clearance Checklist (KSC Form 28-1231NS) will be provided by the KSC IH. Send copies to the Contracting Officer upon satisfactory completion of the work. Notify KSC IH and the Contracting Officer at least three days prior to the planned commencement of work. Coordinate and schedule all Pre-Work and Clearance Site inspections with KSC IH. The completed forms are to be used to establish approval of the containment, work practices and final acceptance/re-occupancy of the work area(s).

3.14 FINAL ACCEPTANCE

The work will not be considered complete until the asbestos materials identified herein have been abated, the areas cleaned, satisfactory clearance air monitoring completed, all asbestos contaminated waste has been properly disposed of, and all project close out documents have been received and approved by the Contracting Officer.

-- End of Section --

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REMOVAL/CONTROL AND DISPOSAL OF PAINT WITH LEAD

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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z88.2	(1992) Respiratory Protection

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

HUD 6780	(1995; Errata Aug 1996;Rev Ch. 7 - 1997) Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing

JOHN F. KENNEDY SPACE CENTER (KSC)

KNPR 8500.1	KSC Environmental Requirements

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
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 745	Lead-Based Paint Poisoning Prevention in Certain Residential Structures

UNDERWRITERS LABORATORIES (UL)

UL 586	(2004) Standard for High-Efficiency Particulate, Air Filter Units

1.2 DEFINITIONS

1.2.1 Abatement

As applied to target housing and child occupied facilities, "abatement" means any set of measures designed to permanently eliminate lead-based paint hazards in accordance with standards established by appropriate Federal agencies. Such term includes:

a. The removal of lead-based paint and lead-contaminated dust, the permanent containment or encapsulation of lead-based paint, the replacement of lead-painted surfaces or fixtures, and the removal or covering of lead contaminated soil; and

b. All preparation, cleanup, disposal, and post-abatement clearance testing activities associated with such measures.

1.2.2 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 in a work environment.

1.2.3 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.

1.2.4 Child Occupied Facility

A building or portion of a building constructed prior to 1978 visited regularly by the same child, 6 years of age or under, on a least two different days within any week, provided each days visit last at least 3 hours and the combined weekly visit last at least 6 hours and the combined annual visit last at least 60 hours. Child occupied facilities may include, but are not limited to day-care centers, preschools and kindergarten classrooms.

1.2.5 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. A Certified Industrial Hygienist (CIH) certified for comprehensive practice 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.

1.2.6 Contaminated Room

Refers to a room for removal of contaminated personal protective equipment (PPE).

1.2.7 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.

1.2.8 Deleading

Activities conducted by a person who offers to eliminate lead-based paint or lead-based paint hazards or to plan such activities in commercial buildings, bridges or other structures.

1.2.9 Eight-Hour Time Weighted Average (TWA)

Airborne concentration of lead to which an employee is exposed, averaged over an 8 hour workday as indicated in 29 CFR 1926.62.

1.2.10 High Efficiency Particulate Air (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron or larger size particles.

1.2.11 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps.

1.2.12 Lead-Based Paint (LBP)

Paint or other surface coating that contains lead in excess of 1.0 milligrams per centimeter squared or 0.5 percent by weight.

1.2.13 Lead-Based Paint Activities

In the case of target housing or child occupied facilities, lead-based paint activities include; a lead-based paint inspection, a risk assessment, or abatement of lead-based paint hazards.

1.2.14 Lead-Based Paint Hazard (LBP Hazard)

Any condition that causes exposure to lead from lead-contaminated dust, lead-contaminated soil, lead-based paint that is deteriorated or present in accessible surfaces, friction surfaces, or impact surfaces that would result in adverse human health effects.

1.2.15 Paint with Lead (PWL)

Any paint that 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 using laboratory instruments with specified limits of detection (usually 0.01%). An X-Ray Fluorescence (XRF) instrument is not considered a valid test method.

1.2.16 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.

1.2.17 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 workday, the PEL shall be determined by the following formula:

PEL (micrograms/cubic meter of air) = 400/No. hrs worked per day

1.2.18 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.

1.2.19 Physical Boundary

Area physically roped or partitioned off around an enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean the same as "outside lead control area but inside the physical boundary."

1.2.20 Target Housing

Housing constructed prior to 1978. It does not include housing for the elderly, or persons with disabilities unless any one or more children age 6 years and younger resides or is expected to reside in such housing.

1.3 DESCRIPTION

1.3.1 Description of Work

Remove/control lead-based/paint with lead as indicated on the drawings. Contractor shall remove paint in accordance with this Section and shall recycle, handle and/or dispose of materials with lead paint in accordance with Federal and State regulations, this Section, and Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION. If a painted surface has not been tested for lead paint, the Contractor shall assume lead is present. Sample and analyze the paint to determine if lead is present.

1.3.2 Coordination with Other Work

The contractor shall coordinate with work being performed in adjacent areas. Coordination procedures shall be explained in the Removal/Control Plan and shall describe how the Contractor will prevent lead exposure to other contractors and/or Government personnel performing work unrelated to lead activities.

1.4 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

Vacuum Filters; G

Respirators; G

SD-06 Test Reports

sampling results; G

Occupational and Environmental Assessment Data Report; G

SD-07 Certificates

Qualifications of CP; G

Testing Laboratory qualifications; G

Occupant Notification; G

Training Certification of workers and supervisors; G

Third Party Consultant Qualifications; G

Lead-based paint/paint with lead removal/control plan including CP approval (signature, date, and certification number); G

Respiratory Protection Program; G

Hazard Communication Program; G

Clearance Certification; G

SD-11 Closeout Submittals

KSC Waste Management Contractor is responsible for disposal of all Hazardous, Controlled, and Universal wastes.

KSC Waste Management Internal Manifest; G

Certification of Medical Examinations; G

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

1.5.1.1 Qualifications of CP

Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph entitled "Competent Person (CP) Responsibilities." Provide previous experience of the CP. Submit proper documentation that the CP is trained, licensed, and certified in accordance with Federal, State, and local laws.

1.5.1.2 Training Certification

Submit a certificate for each employee and supervisor, signed and dated by the training provider meeting 40 CFR 745 (Subpart L) requirements, stating that the employee or supervisor has received the required lead training and

is certified to perform or supervise deleading or lead removal. Submit proof the work will be performed by a certified firm.

1.5.1.3 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected to perform the air and wipe sampling, testing, and reporting of airborne concentrations of lead. Use a laboratory accredited under the EPA National Lead Laboratory Accreditation Program (NLLAP) by either the American Association for Laboratory Accreditation (A2LA) or the American Industrial Hygiene Association (AIHA) and that is successfully participating in the Environmental Lead Proficiency Analytical Testing (ELPAT) program to perform sample analysis. Laboratories selected to perform blood lead analysis shall be OSHA approved.

1.5.1.4 Third Party Consultant Qualifications

Submit the name, address, and telephone number of the third party consultant selected to perform the wipe sampling for determining concentrations of lead in dust or soil sampling. 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.

1.5.2 Requirements

1.5.2.1 Competent Person (CP) Responsibilities

a. Verify training meets all federal, State, and local requirements.

b. Review and approve lead-based paint/paint with lead removal/control plan for conformance to the applicable standards. Ensure work is performed in strict accordance with specifications at all times.

c. Continuously inspect lead-based paint removal/control work for conformance with the approved plan.

d. Perform air and wipe sampling.

e. Control work to prevent hazardous exposure to human beings and to the environment at all times.

f. Certify the conditions of the work as called for elsewhere in this specification.

1.5.2.2 Lead-Based Paint/Paint with Lead Removal/Control Plan (LBP/PWL R/CP)

Submit a detailed job-specific plan of the work procedures to be used in the removal/control of LBP/PWL. The plan shall include a sketch showing the location, size, and details of lead control areas, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include a description of equipment and materials, controls and job responsibilities for each activity from which lead is emitted. Include in the plan, eating, drinking, smoking and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and paint debris disposal plan, air sampling plan, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that lead is not released outside the lead control area. Include site preparation, cleanup and clearance procedures. Include

occupational and environmental sampling, training, sampling methodology, frequency, 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 multi-contractor worksites to inform affected employees and to clarify responsibilities to control exposures.

The Removal/Control Plan shall be developed by a certified planner/project designer.

In occupied buildings, the Removal/Control Plan shall also include an occupant protection program that describes the measures that will be taken during the work to protect the building occupants.

1.5.2.3 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 Removal/Control 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.

1.5.2.4 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. Maintain complete and accurate medical records of employees for a period of at least 30 years or for the duration of employment plus 30 years, whichever is longer.

1.5.2.5 Training

Train each employee performing paint removal, 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.

1.5.2.6 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 ANSI Z88.2, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

1.5.2.7 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

1.5.2.8 Waste Management

The Waste Management Plan shall be in accordance with Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION.

1.5.2.9 Environmental, Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of Federal, State, local authorities, and KNPR 8500.1 regarding removing, handling, storing, transporting, and disposing of lead waste materials. 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 Federal and State laws, ordinances, criteria, rules and regulations regarding removing, handling, storing, transporting, and disposing of lead-contaminated materials apply:

a. 40 CFR 745 (Subpart L)

b. 29 CFR 1926.62

Licensing and certification in the State of Florida is required.

1.5.3 Pre-Construction Conference

Along with the CP, meet with the Contracting Officer to discuss in detail the waste management plan and the lead-based paint/paint with lead removal/control plan, including work procedures and precautions for the removal plan.

1.6 EQUIPMENT

1.6.1 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. Respirators shall comply with the requirements of 29 CFR 1926.62.

1.6.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with proper disposable protective whole body clothing, head covering, gloves, 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.

1.6.3 Rental Equipment Notification

If rental equipment is to be used during lead-based paint handling and disposal, notify the rental agency in writing concerning the intended use of the equipment. Furnish a copy of the written notification to the Contracting Officer.

1.6.4 Vacuum Filters

UL 586 labeled HEPA filters.

1.6.5 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 paint removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, and hand protection. PPE shall remain the property of the Contractor. The Government will provide respiratory protection for the Contracting Officer.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Protection of Existing Work to Remain

Perform paint removal work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better.

PART 2 PRODUCTS

Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Protection

3.1.1.1 Notification

a. Notify the Contracting Officer 20 days prior to the start of any paint removal work.

b. Occupant Notification

Submit occupant written acknowledgment of the delivery of lead hazard information pamphlet (EPA 747-K-99-001 "Protect Your Family From Lead in Your Home") prior to commencing the renovation work for each affected unit per 40 CFR 745 Subpart E.

3.1.1.2 Boundary Requirements

a. 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 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 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.

3.1.1.4 Decontamination Facility

Provide clean and contaminated change rooms in accordance with this specification and 29 CFR 1926.62.

3.1.1.5 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.

3.1.1.6 Mechanical Ventilation System

a. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.62.

b. To the extent feasible, use local exhaust ventilation connected to HEPA filters or other collection systems, approved by the CP. Local exhaust ventilation systems shall be evaluated and maintained in accordance with 29 CFR 1926.62.

c. Vent local exhaust outside the building only and away from building ventilation intakes.

d. Use locally exhausted, power actuated, paint removal tools.

3.1.1.7 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 situating critical barriers and physical boundaries around the area or structure where LBP/PWL removal/control

operations will be performed.

3.3 APPLICATION

3.3.1 Work Procedures

Perform removal of lead-based paint in accordance with approved lead-based paint/paint with lead removal/control plan. Use procedures and equipment required to limit occupational and environmental exposure to lead when lead-based paint is removed in accordance with 29 CFR 1926.62. Dispose of removed paint chips and associated waste in compliance with Environmental Protection Agency (EPA), State, and local requirements.

3.3.2 Lead-Based Paint Removal/Control/Deleading

Manual or power sanding of interior and exterior surfaces 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 LBP removal/control in work plan. Remove paint within the areas designated on the drawings in order to completely expose the substrate. Take whatever precautions necessary to minimize damage to the underlying substrate.

Provide methodology for LBP/PWL removal and abatement/control and processes to minimize contamination of work areas outside the control area with lead-contaminated dust or other lead-contaminated debris/waste and to ensure that unprotected personnel are not exposed to hazardous concentrations of lead. Describe this LBP/PWL removal/control process in the LBP/PWL R/CP.

3.3.2.1 Outdoor Paint Removal

Perform outdoor removal as indicated in federal, State, and local regulations and in the LBP/CPR/CP. The worksite preparation (barriers or containments) shall be job dependent and presented in the LBP/PWL R/CP.

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 during the work day:

a. Vacuum themselves off.

b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.

c. Change to clean clothes prior to leaving the physical boundary designated around the lead control area.

3.4 FIELD QUALITY CONTROL

3.4.1 Tests

3.4.1.1 Air and Wipe Sampling

Air sample 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 non-clearance wipe sampling and inspecting the lead-based paint removal/control work to ensure that the requirements of the contract have been satisfied during the entire lead-based paint removal operation.

b. Collect personal air samples on employees who are expected to have the greatest risk of exposure as determined by the CP. In addition, collect air samples on at least 25 percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.

c. Submit results of air samples, within 72 hours after the air samples are taken.

d. Before any work begins, a third party consultant shall collect and analyze baseline wipe samples in accordance with methods defined in federal, State, and local standards inside and outside of the physical boundary to assess the degree of dust contamination in the facility prior to lead-based paint removal/control.

e. Collect surface wipe samples at a location no greater than 10 feet outside the lead control area at a frequency of once per day while lead removal work is conducted. Surface wipe results shall meet criteria in paragraph "Clearance Certification."

3.4.1.2 Air Sampling During Paint Removal Work

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. For outdoor operations, at least one sample on each shift shall be taken on the downwind side of the lead control area.

3.4.1.3 Sampling After Paint Removal/Control

After the visual inspection, collect wipe samples according to the HUD protocol contained in HUD 6780 to determine the lead content of settled dust and dirt in micrograms per square meter foot of surface area.

3.4.1.4 Testing of Removed Paint and Used Abrasive

Test removed paint and used abrasive 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 paint chips and dust. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean up the area. At the end of each shift and when the paint removal operation has been completed, clean the area of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping

the area and wet wiping the area as indicated by the CP. Reclean areas showing dust or residual paint chips or debris. After visible dust, chips and debris is removed, wet wipe and HEPA vacuum all surfaces in the work 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 restarting work.

3.5.1.1 Clearance Certification

The CP shall certify in writing that air samples collected outside the lead control area during paint removal operations are less than 30 micrograms per cubic meter of air; the respiratory protection used for the employees was adequate; the work procedures were performed in accordance with 29 CFR 1926.62 and 40 CFR 745; and that there were no visible accumulations of material and dust containing lead left in the work site. Do not remove the lead control area or roped off boundary and warning signs prior to the Contracting Officer's acknowledgement of receipt of the CP certification.

For lead-based paint hazard abatement work, surface wipe shall be conducted and clearance determinations made according to the work practice standards presented in 40 CFR 745.227.

3.5.2 Disposal

a. 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 262. Dispose of lead-contaminated waste material in accordance with Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION paragraph "Materials Management and Waste Disposal," and contract clause "Hazardous Waste."

b. The result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.

3.5.2.1 Disposal Documentation

Contractor shall, in accordance with the contract clause "Hazardous Waste," provide all KSC Waste Management internal manifest copies upon completion of the project to the Contracting Officer.

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SECTION 02 84 33

REMOVAL AND DISPOSAL OF POLYCHLORINATED BIPHENYLS (PCBs)

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.

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

29 CFR 1910.1000	Air Contaminants
29 CFR 1910.145	Accident Prevention Signs and Tags
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
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 174	Carriage by Rail
49 CFR 175	Carriage by Aircraft
49 CFR 176	Carriage by Vessel
49 CFR 177	Carriage by Public Highway
49 CFR 178	Specifications for Packagings
49 CFR 179	Specifications for Tank Cars

1.2 REQUIREMENTS

The work includes the removal and disposal of material containing PCBs located in paint coatings, caulking, and electrical equipment, and as indicated on the drawings. Perform work in accordance with 40 CFR 761 and the requirements specified herein.

1.3 DEFINITIONS

1.3.1 Leak

Leak or leaking means any instance in which a PCB Article, PCB Container, or PCB Equipment has any PCBs on any portion of its external surface.

1.3.2 PCBs

PCBs as used in this specification shall mean the same as PCBs, PCB Article, PCB Article Container, PCB Container, PCB Equipment, PCB Item, PCB Transformer, PCB-Contaminated Electrical Equipment, as defined in 40 CFR 761, Section 3, Definitions.

1.3.3 Spill

Spill means both intentional and unintentional spills, leaks, and other uncontrolled discharges when the release results in any quantity of PCBs running off or about to run off the external surface of the equipment or other PCB source, as well as the contamination resulting from those releases.

1.4 QUALITY ASSURANCE

1.4.1 Training

Instruct employees on the dangers of PCB exposure, on respirator use, decontamination, and applicable OSHA and EPA regulations.

1.4.2 Certified Industrial Hygienist (CIH)

Obtain the services of an industrial hygienist certified by the American Board of Industrial Hygiene to certify training, review and approve the PCB removal plan, including determination of the need for personnel protective equipment (PPE) in performing PCB removal work.

1.4.3 Regulation Documents

Maintain at all times one copy each at the office and one copy each in view at the job site 29 CFR 1910.1000, 40 CFR 761, and Contractor work practices for removal, storage and disposal of PCBs.

1.4.4 Surveillance Personnel

Surveillance personnel may enter PCB control areas for brief periods of time provided they wear disposable polyethylene gloves and disposal polyethylene foot covers, as a minimum. Additional protective equipment may be required if respiratory hazard is involved or if skin contact with PCB is involved.

1.5 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-07 Certificates

Training certification

Qualifications of CIH

PCB removal work plan

PCB disposal plan

Notification

1.6 EQUIPMENT

1.6.1 Special Clothing

Work clothes shall consist of PPE as required by OSHA regulations, including, but not limited to the following:

a. Disposable coveralls

b. Gloves (Disposable rubber gloves may be worn under these)

c. Disposable foot covers (polyethylene)

d. Chemical safety goggles

e. Half mask cartridge respirator.

1.6.2 Special Clothing for Government Personnel

Provide PPE specified in paragraph entitled "Special Clothing" to the Contracting Officer as required for inspection of the work.

1.6.3 PCB Spill Kit

Assemble a spill kit to include the following items:

	ITEM	MINIMUM QUANTITY
1.	Disposable gloves (polyethylene)	6 prs
2.	Gloves with a high degree of impermeability to PCB	6 prs
3.	Disposable coveralls with permeation resistance to PCB	4 ea
4.	Chemical safety goggles	2 ea
5.	Disposable foot covers (polyethylene)	6 prs
6.	PCB Caution Sign: "PCB Spill--Authorized Personnel Only"	2 ea
7.	Banner guard or equivalent banner material	100 feet
8.	Absorbent material	
9.	Blue polyethylene waste bags	5 bags
10.	Cloth backed tape	5 ea
11.	Area access logs, blank	1 roll
12.	Brattice cloth, 6' x 6'	10 ea
13.	Rags	1 piece
14.	Ball point pens	20 ea
15.	Herculite, 4' x 4' and	2 ea
	8' x 8'	1 ea
16.	Blank metal signs and grease pencils	

ITEM	MINIMUM QUANTITY
17. Waste containers 55 gallon	2 ea
drum, may be used as container for kit)	1 ea

1.7 QUALITY ASSURANCE

1.7.1 Training Certification

Submit certificates, prior to the start of work but after the main abatement submittals, signed and dated by the CIH and by each employee stating that the employee has received training. Certificates shall be organized by individual worker, not grouped by type of certificates.

1.7.2 Qualifications of CIH

Submit the name, address, and telephone number of the Industrial Hygienist selected to perform the duties in paragraph entitled "Certified Industrial Hygienist." Submit proper documentation that the Industrial Hygienist is certified, including certification number and date of certification/recertification.

1.7.3 PCB Removal Work Plan

Submit a detailed job-specific plan of the work procedures to be used in the removal of PCB-containing materials, not to be combined with other hazardous abatement plans. Provide a Table of Contents for each abatement submittal which shall follow the sequence of requirements in the contract. The plan shall include a sketch showing the location, size, and details of PCB control areas, location and details of decontamination rooms, change rooms, shower facilities, and mechanical ventilation system. Include in the plan, eating, drinking, smoking and restroom procedures, interface of trades, sequencing of PCB related work, PCB disposal plan, respirators, protective equipment, and a detailed description of the method of containment of the operation to ensure that PCB contamination is not spread or carried outside of the control area. Include provisions to ensure that airborne PCB concentrations of 3.10 E-08 pound per cubic feet of air are not exceeded outside of the PCB control area. Include air sampling, training and strategy, sampling methodology, frequency, duration of sampling, and qualifications of air monitoring personnel in the air sampling portion of the plan. Obtain approval of the plan prior to the start of PCB removal work.

1.7.4 PCB Disposal Plan

Submit a PCB Disposal Plan within 45 calendar days after award of contract for Contracting Officer's approval. The PCB Disposal Plan shall comply with applicable requirements of Federal, State, and local PCB waste regulations and Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION and address:

a. Identification of PCB 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 PCB 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 to be implemented.

g. Work plan and schedule for PCB waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily.

1.7.5 Notification

Notify the Contracting Officer 20 days prior to the start of PCB removal work.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Decontamination Room, Clean Room and Shower Facilities

a. Provide material and labor for construction of a decontamination room, a clean room, and shower facilities. Provide rooms with doors and attach to the exit ways of PCB work areas. Rooms shall be of sufficient size to accommodate the Contractor's operation within. Existing facilities with water closets, urinals, wash basins and showers may be used if available to the Contractor. Provide portable toilet and shower facilities. Locate shower facilities between the clean room and decontamination room. Provide separate clothing lockers or containers in each room to prevent contamination of street and work clothes.

b. Remove PCB-contaminated PPE in the decontamination room. Workers shall then proceed to showers. Workers shall shower before lunch and at the end of each day's work. Hot water, towels, soap, and hygienic conditions are the responsibility of the Contractor.

3.1.2 PCB Control Area

Isolate PCB control area by physical boundaries to prevent unauthorized entry of personnel. Food, drink and smoking materials shall not be permitted in areas where PCBs are handled or PCB items are stored.

3.1.3 Personnel Protection

Workers shall wear and use PPE, as recommended by the Industrial Hygienist, upon entering a PCB control area. If PPE is not required per the CIH, specify in the PCB removal work plan.

3.1.4 Footwear

Work footwear shall remain inside work area until completion of the job.

3.1.5 Permissible Exposure Limits (PEL)

PEL for PCBs is 3.1 E-08 lb/cubic foot on an 8-hour time weighted average basis.

3.1.6 Special Hazards

a. PCBs shall not be exposed to open flames or other high temperature sources since toxic decomposition by-products may be produced.

b. PCBs shall not be heated to temperatures of 135 degrees F or higher without Contracting Officer's concurrence.

3.1.7 PCB Caution Label

40 CFR 761, Subpart C. Affix labels to PCB waste containers and other PCB-contaminated items. Provide label with sufficient print size to be clearly legible, with bold print on a contrasting background, displaying the following: CAUTION: Contains PCBs (Polychlorinated Biphenyls).

3.1.8 PCB Caution Sign

29 CFR 1910.145. Provide signs at approaches to PCB control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area.

3.2 WORK PROCEDURE

Furnish labor, materials, services, and equipment necessary for the complete removal of PCBs located at the site as indicated or specified in accordance with local, State, or Federal regulations. Package and mark PCB as required by EPA and DOT regulations and dispose of off Government property in accordance with EPA, DOT, and local regulations at a permitted site.

3.2.1 No Smoking

Smoking is not permitted within 50 feet of the PCB control area. Provide "No Smoking" signs as directed by the Contracting Officer.

3.2.2 Work Operations

Ensure that work operations or processes involving PCB or PCB-contaminated materials are conducted in accordance with 40 CFR 761 and the applicable requirements of this section, including but not limited to:

a. Obtaining advance approval of PCB storage sites.

b. Notifying Contracting Officer prior to commencing the operation.

c. Reporting leaks and spills to the Contracting Officer.

d. Cleaning up spills.

e. Maintaining an access log of employees working in a PCB control area and providing a copy to the Contracting Officer upon completion of the operation.

f. Inspecting PCB and PCB-contaminated items and waste containers for leaks and forwarding copies of inspection reports to the Contracting Officer.

g. Maintaining a spill kit as specified in paragraph entitled "PCB Spill Kit."

h. Maintaining inspection, inventory and spill records.

3.3 PCB TRANSFORMERS

3.3.1 Draining of Transformer Liquid

Perform work in accordance with 49 CFR 171, 49 CFR 172, 49 CFR 173, 49 CFR 174, 49 CFR 175, 49 CFR 176, 49 CFR 177, 49 CFR 178, and 49 CFR 179, Subchapter C and as specified herein. Drain the transformer, switches, and regulators of free flowing liquid prior to transportation. Place the drained liquids in DOT Spec 17E drums. The drums shall not contain more than 50 gallons of oil. If the equipment cannot be drained, then place it in DOT Spec 17C drums.

3.3.2 Markings

Provide drums and drained PCB-contaminated electrical equipment with caution label markings as specified in paragraph entitled "PCB Caution Label."

3.3.3 Laboratory Analysis

All transformers shall have a laboratory analysis for turn-in. The only two exceptions to this rule are:

a. The transformer is hermetically sealed (solder sealed or fusion sealed. No access ports or openings).

b. The name plate states that the transformer contains pyranol, interteen, etc.

Attach a copy of the lab analysis to both the DD 1348-1 and the transformer itself.

3.3.4 Markings

3.3.4.1 Transformers, Less Than 50 ppm

Add conventional absorbent material specified for spill containment to absorb residue oil remaining after draining. Write the date drained on the transformer. Turn in transformers to the RRMF. Telephone 861-8795 to schedule appointment for turn-in.

3.3.4.2 Transformers, 50-499 ppm

Same procedure as transformers in the less than 50 ppm range.

3.3.4.3 Transformers, Greater Than 500 ppm

Stencil date drained on the transformer. Turn in transformer to the RRMF.

3.3.4.4 Drums

Stencil on DOT-approved 55 gallon drums containing PCB liquid the following:

a. ppm

b. Date drum filled

c. Serial number of transformer liquid came from

d. National Stock Number

(1) "9999-00-OIL" for <50 ppm

(2) "9999-00-CONPCB" for 50-499 ppm

(3) "9999-00-PCBOIL" for >500 ppm

Do not mix different ppms in the same drum. Drums must have a 2 inch ullage space from the top of the drum.

3.4 PCB REMOVAL

Select PCB removal procedure to minimize contamination of work areas with PCB or other PCB-contaminated debris/waste. Handle PCBs such that no skin contact occurs. PCB removal process should be described in the work plan.

3.4.1 Confined Spaces

As feasible, do not carry out PCB handling operations in confined spaces. A confined space shall mean a space having limited means of egress and inadequate cross ventilation.

3.4.2 Control Area

Establish a PCB control area around the PCB item as specified in paragraph entitled "PCB Control Area." Only personnel briefed on the elements in the paragraph entitled "Training" and on the handling precautions shall be allowed into the area.

3.4.3 Exhaust Ventilation

If used, exhaust ventilation for PCB operations shall discharge to the outside and away from personnel.

3.4.4 Temperatures

As feasible, handle PCBs at ambient temperatures and not at elevated temperatures.

3.4.5 Solvent Cleaning

Clean contaminated tools, containers, etc., after use by rinsing three times with an appropriate solvent or by wiping down three times with a solvent wetted rag. Suggested solvents are stoddard solvent or hexane.

3.4.6 Drip Pans

Drip pans are required under portable PCB transformers and rectifiers in

use or stored for use. The pans shall have a containment volume of at least one and one-half times the internal volume of PCBs in the item.

3.4.7 Evacuation Procedures

Procedures shall be written for evacuation of injured workers. Aid for a seriously injured worker shall not be delayed for reasons of decontamination.

3.5 PCB SPILL CLEANUP REQUIREMENTS

3.5.1 PCB Spills

Immediately report to the Contracting Officer any PCB spills on the ground or in the water, PCB spills in drip pans, or PCB leaks. Handle, contain, and document spills in accordance with contract clause "Spills".

3.5.2 PCB Spill Control Area

Rope off an area around the edges of a PCB leak or spill and post a "PCB Spill Authorized Personnel Only" caution sign. Immediately transfer leaking items to a drip pan or other container.

3.5.3 PCB Spill Cleanup

Contractor shall contain spills and document the spill area to ensure it is PCB-free. Handle spills in accordance with the contract clause "Spills." The KSC Spill Cleanup Team will be responsible for final cleanup of a spill.

3.6 STORAGE FOR DISPOSAL

3.6.1 Storage Containers for PCBs

Store PCBs in Government provided containers.

3.6.2 Waste Containers

Label as directed by the Government.

3.6.3 PCB Articles and PCB-Contaminated Items

Label as directed by the Government.

3.6.4 Approval of Storage Site

Storage sites shall be in accordance with the contract clause "PCB Management".

3.7 CLEANUP

Maintain surfaces of the PCB control area free of accumulations of PCBs. Restrict the spread of dust and debris; keep waste from being distributed over work area.

a. Do not remove the PCB control area and warning signs prior to the Contracting Officer's approval. Reclean areas showing residual PCBs.

3.8 PCB DISPOSAL AND MANAGEMENT

Comply with disposal requirements and procedures outlined in the contract clause "PCB Management" and 40 CFR 761.

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SECTION 03 01 30.71

CONCRETE REHABILITATION

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 C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 144	(2004) Standard Specification for Aggregate for Masonry Mortar
ASTM C 31/C 31M	(2009) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	(2005e1e2) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 881/C 881M	(2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

1.2 DEFINITIONS

1.2.1 Epoxy Resin Binder

A two-component epoxy bonding system in low and medium viscosities used by itself as a primer or for producing epoxy concrete or mortars when mixed with aggregate.

1.2.2 Epoxy Concrete

A combination of epoxy resin binder and fine and coarse aggregate used in the repair of spalling along joints or cracks, small surface spalls or "popouts."

1.2.3 Epoxy Mortar

A combination of epoxy resin binder and fine aggregate used in the surface repair of non-structural cracks and filling of saw kerfs.

1.2.4 Non-Pressure Epoxy Grout

A combination of epoxy resin binder, a mineral filler and a thixotropic agent used in cementing dowels in place and the repair of non-structural cracks.

1.2.5 Pressure Grouting Epoxy

A low viscosity epoxy resin system pumped under pressure into structural cracks in walls or pavements.

1.3 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-05 Design Data

Job mix formula

SD-06 Test Reports

Sieve analysis test for aggregate

SD-07 Certificates

Epoxy resin binder

Epoxy grout

SD-08 Manufacturer's Instructions

Epoxy repair material

Submit for mixing and applying.

1.4 QUALITY ASSURANCE

1.4.1 Design Data

1.4.1.1 Job Mix Formula

Submit at least 15 days before work commences, a job-mix formula for each use of epoxy concrete or epoxy mortar. Test reports shall accompany the mix design. Identify the proposed source of the materials and state the proportions of aggregates and epoxy resin. When determining job mix, use samples of materials to be used on the job.

a. Trial batches: Perform a minimum of three trial batchings in a certified testing laboratory. Try different aggregate-resin proportions to obtain satisfactory placing and finishing characteristics but keep the proportion by weight of aggregate to epoxy resin binder at least five to one. When mixing, add the fine aggregates first, and then the coarse aggregates. The final trial batch should be sufficiently wet so that some fines will "bleed" to the surface during finishing operations.

b. Supporting criteria: Include in the submittal the following data for each trial batch:

(1) Proportions by weight

(2) Unit weights and specific gravities of constituents
(3) Batch weights

(4) Compressive strengths of 3 by 6 inch cylinders, made in accordance with ASTM C 31/C 31M, air cured for 7 days and tested in accordance with ASTM C 39/C 39M. Compressive strength shall be a minimum of 7,000 psi.

(5) Curing time

1.5 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to site for damage, unload and store with a minimum of handling. Deliver epoxy resin components and aggregate materials in original sealed containers and store in dry covered areas at temperatures below 90 degrees F. Remove from job site unused mixed materials which have reached end of working or pot life.

1.6 WEATHER LIMITATIONS

Halt work when weather conditions detrimentally affect the quality of patching or bonding concrete. Apply epoxy resin materials only when the contact surfaces are completely dry and if the atmospheric and surface temperature ranges are suitable for the specified epoxy material. Follow manufacturer's instructions for weather conditions and temperature ranges.

1.7 TRAFFIC CONTROL

Do not permit vehicular or heavy equipment traffic on the pavement in the work area during the curing period. At the end of the curing period, light local traffic may be permitted on the pavement if approved by the Contracting Officer.

1.8 EQUIPMENT

Use a container recommended by the epoxy manufacturer as the mixing vessel. Use a power drive (air or spark-proof) propeller type blade for mixing except that hand mixing may be used for small batches. Use equipment specified by epoxy manufacturer for field mixing of aggregates and epoxy resin.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Epoxy

2.1.1.1 Epoxy Resin Binder for Concrete and Mortar

ASTM C 881/C 881M, Type III, Grade 1, Class B or C without mineral filler. For walls and ceilings use ASTM C 881/C 881M, Type III, Grade 3, Class B or C with filler.

2.1.1.2 Non-Pressure Epoxy Grout

ASTM C 881/C 881M Type IV, Grade 2, Class B or C with or without mineral filler.

2.1.1.3 Crack Sealer for Pressure Grouting

ASTM C 881/C 881M, Type IV, Grade 1, Class B or C without filler.

2.1.1.4 Crack Surface Sealer for Pressure Grouting

ASTM C 881/C 881M, Type IV, Grade 3, Class B or C with mineral filler.

2.1.2 Aggregate

For material passing No. 200 sieve provide a non-plastic material composed of a minimum of 75 percent limestone dust, talc or silica inert filler. Provide dry aggregate.

a. For epoxy concrete: ASTM C 33/C 33M, maximum size 1/2 inch. Conform to the following requirements:

Sieve Designation	Percent Passing by Weight
1/2 in.	100
3/8 in.	93-100
No. 4	70-80
No. 8	50-65
No. 16	37-53
No. 30	20-37
No. 50	10-20
No. 100	5-10
No. 200	3-5

b. For epoxy mortar: ASTM C 144, maximum size No. 40 sieve.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Epoxy Concrete

3.1.1.1 Patch Areas

Remove loose concrete from the spalled areas indicated. Inspect the cavity for remaining defective concrete by tapping with a hammer or steel rod and listening for dull or hollow sounds. In areas where tapping does not produce a solid tone, remove additional concrete until testing produces a solid tone. Make the entire cavity at least one inch deep. Sawcut edges of cavity to avoid feather edging. Prepare surface of cavity by sandblasting, grinding, or water blasting. Remove dust, dirt, and loosely bonded material resulting from cleaning. Ensure cavity surfaces are dry.

3.1.1.2 Spalls at Joints and Cracks

For spalls to be repaired that are adjacent to joints and working cracks insert preformed joint filler to the working faces of the spall. Trim filler to fit shape of the working faces of joint or crack so epoxy

material is prevented from bypassing filler. Where practicable, extend filler horizontally and vertically into joint or crack opening. Secure filler strip in place prior to and during placement of epoxy concrete. Apply a bond breaker to working faces at keyed joints. Keep bond breaker off of concrete surface to be bonded. After the epoxy concrete has completely cured, saw out the top inch of the preformed joint filler and install liquid joint sealer.

3.1.2 Epoxy Mortar for Cracks and Saw Kerfs

Apply epoxy mortar to newly exposed loose and unsound materials. Prepare surfaces by sandblasting, scarifying or waterblasting. Remove dust, dirt, and loosely bonded material resulting from cleaning. Ensure surfaces are dry before application of epoxy mortar.

3.1.3 Epoxy Grout for Cracks

Apply grout to newly exposed concrete free of loose and unsound materials. Prepare surfaces by sandblasting, scarifying or waterblasting. Remove dust, dirt, and loosely bonded material resulting from cleaning. Ensure surfaces are dry before application of epoxy grout.

3.2 MIXING MATERIALS

Make batches small enough to ensure placement before binder sets. Mix materials in accordance with manufacturer's recommendations.

3.3 PLACEMENT

3.3.1 Epoxy Concrete

Prime dry cavity surfaces with epoxy resin using a stiff bristle brush. Make coating approximately 20 mils thick. Place epoxy concrete while primer is still tacky and in layers not exceeding one inch thick. Use vibratory floats, plates, or hand tampers to consolidate the concrete. Level each layer and screed the final surface to match the adjoining surfaces. Remove excess epoxy concrete on adjacent surfaces before the concrete hardens. Do not feather epoxy concrete out onto adjacent surfaces.

3.3.2 Epoxy Mortar

Prime surfaces with epoxy resin binder. Scrub prime coat into surface with a stiff bristle brush. Make coating approximately 20 mils thick. Place epoxy mortar while primer is still tacky. Apply at a thickness recommended by the manufacturer. Work mortar into place and consolidate thoroughly so that contact surfaces are wetted by the mortar. Finish surface of mortar to the required texture. Do not feather edge epoxy mortar onto adjacent surfaces.

3.3.3 Non-Pressure Epoxy Grout

3.3.3.1 Cementing Dowels

Immediately prior to placing the dowel, clean hole of dust and other deleterious material with a high pressure air hose. Fill hole halfway with grout. Insert dowel in hole by rotating it at least one complete turn while tapping it down. If necessary add more grout to fill hole.

3.3.3.2 Epoxy Grout for Cracks

Apply epoxy grout at a thickness recommended by the manufacturer. Work grout into place and consolidate thoroughly so that contact surfaces are wetted by the grout. Finish surface of grout to the required texture. Do not feather edge epoxy grout onto adjacent surfaces.

3.3.4 Pressure Grouting of Cracks

Clean each crack of dust, dirt, loose concrete and unsound material. Insert a valve at both ends of each crack, at the junction of two cracks, and along the length of each crack at 16 to 20 inch intervals. Fill crack between valves with crack surface sealer. After crack surface sealer has hardened and cured, pump crack sealer into valve at one end of crack. For vertical surfaces start at lowest valve and work upwards. As crack sealer appears at next valve, pinch closed pumping valve and move to next valve and commence pumping. Continue procedure until other end of crack is reached. Avoid delays in pumping operation. After crack sealer has hardened and cured grind valves off flush with concrete surface. Coat areas of valves with crack surface sealer and allow to harden and cure.

3.4 CURING

Cure epoxy materials in accordance with manufacturer's recommendations.

3.5 FIELD QUALITY CONTROL

3.5.1 Sampling

As soon as epoxy resin and aggregate materials are available for sampling, obtain by random selection a sample of each batch. Clearly identify samples by designated name, specification number, batch number, project contract number, intended use and quantity involved.

3.5.2 Testing

At the discretion of the Contracting Officer, samples provided may be tested by the Government for verification. Test samples by an approved laboratory. If a sample fails to meet specification requirements after two tests, replace the batch represented by the samples tested and retest. Test aggregates in accordance with ASTM C 117 and ASTM C 136.

3.5.3 Inspection

Check each repaired area for cracks, spalls, popouts and loss of bond between repaired area and surrounding concrete. Check each repaired area for voids by tapping with a hammer or steel rod and listening for dull or hollow sounds. Immediately repair defects.

-- End of Section --

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CAST-IN-PLACE CONCRETE

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.

ACI INTERNATIONAL (ACI)

ACI/MCP-1	(2008) Manual of Concrete Practice Part 1: ACI 104-71R-97 to 223-98
ACI/MCP-2	(2008) Manual of Concrete Practice Part 2 - ACI 224R-01 to ACI 313R-97
ACI/MCP-3	(2008) Manual of Concrete Practice Part 3 - ACI 315-99 to ACI 343R-95
ACI/MCP-4	(2008) Manual of Concrete Practice Part 4 - ACI 345R-05 to 355.2R-04

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 322M/M 322	(2007) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

ASTM INTERNATIONAL (ASTM)

ASTM A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 496/A 496M	(2007) Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497/A 497M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A 615/A 615M	(2009) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 82/A 82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 996/A 996M	(2006a) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars or Concrete Reinforcement

ASTM C 1107/C 1107M	(2008) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 143/C 143M	(2009) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 156	(2005) Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 172	(2008) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 173/C 173M	(2009) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(2007) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(2009a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2009) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 311	(2007) Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
ASTM C 33	(2007) Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	(2005e1e2) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(2004) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(2008a) Standard Specification for Chemical Admixtures for Concrete

ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 881/C 881M	(2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM C 932	(2006) Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering
ASTM C 94/C 94M	(2009) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(2009a) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM D 1190	(1997) Standard Specification for Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1557	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 1751	(2004) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 5759	(1995; R 2005) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM E 329	(2008) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM E 648	(2008) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2001; 27Ed) Manual of Standard Practice

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS MMM-A-001993	(1978) Adhesive, Epoxy, Flexible, Filled (For Binding, Sealing, and Grouting)

1.2 DEFINITIONS

a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, ground granulated blast-furnace slag, and silica fume.

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 desired 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).

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings for concrete must be submitted by the Contractor in accordance with paragraph entitled, "Shop Drawings," of this section, to include the following:

Reinforcement Materials; G

Reproductions of contract drawings are unacceptable.

SD-03 Product Data

Curing Concrete Elements
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.

Joint filler
Cement
Portland Cement
Ready-Mix Concrete

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product.

SD-05 Design Data

Concrete mix design; G

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.

SD-06 Test Reports

Compressive strength tests

1.4 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 Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. Reference 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.

1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.6 QUALITY ASSURANCE

1.6.1 Drawings

1.6.1.1 Shop Drawings

Fabrication drawings for reinforcement materials must indicate concrete pressure calculations with both live and dead loads, along with material types. Provide all design calculations in accordance with ACI/MCP-2 and ACI/MCP-3.

1.6.2 Control Submittals

1.6.2.1 Curing Concrete Elements

Submit proposed materials and methods for curing concrete elements.

1.6.3 Test Reports

1.6.3.1 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.

1.7 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.

PART 2 PRODUCTS

2.1 CONCRETE

2.1.1 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 Maximum Nominal Aggregate (Size No.)	Range of Slump (inches)	Maximum Water-Cement Ratio (by weight)	Air Entr. (percent)
Concrete exposed to weather	4000	57	1 to 4	0.45	6

2.1.1.1 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, silica fume, 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.

2.1.1.2 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.

2.1.2 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

2.1.3 Concrete Curing Materials

2.1.3.1 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.

2.1.3.2 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.

2.2 MATERIALS

2.2.1 Cement

ASTM C 150, Type I or II blended cement except as modified herein. Provide blended cement that consists of a mixture of ASTM C 150, 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. Supplier must certify that the hazardous waste is neutralized by the manufacturing process and that no additional pollutants are discharged. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.2.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N, 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 15 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:

1. For ground granulated blast-furnace (GGBF) slag: 50 percent

2. For fly ash or natural pozzolan: 40 percent (25 percent in cold climates)

3. For silica fume: 10 percent

2.2.1.2 Portland Cement

Provide cement that conforms to ASTM C 150, Type I, IA, II, or IIA. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

2.2.2 Water

Minimize the amount of water in the mix. The amount of water must not exceed 45 percent by weight of cementitious materials (cement + pozzolans), and in general, improve workability by adjusting the grading rather than by adding water. Water must be fresh, clean, and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

2.2.3 Aggregates

ASTM C 33, 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.

2.2.4 Nonshrink Grout

ASTM C 1107/C 1107M.

2.2.5 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.

2.2.5.1 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C 494/C 494M, Type F.

2.2.5.2 Pozzolan

Provide fly ash or other pozzolans used as admixtures that conform to ASTM C 618.

2.2.6 Materials for Curing Concrete

Consider agents that are not toxic and emit low or no Volatile Organic Compounds (VOC).

2.2.6.1 Liquid Membrane-Forming Compound

ASTM C 309, white-pigmented, Type 2, Class B.

2.2.7 Expansion/Contraction Joint Filler

ASTM D 1751. Material must be 1/2 inch thick, unless otherwise indicated.

2.2.7.1 Preformed Joint Filler Strips

Provide nonextruding and resilient bituminous type filler strips conforming to ASTM D 1751.

2.2.8 Joint Sealants

Use concrete penetrating sealers with a low VOC content.

2.2.8.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D 1190 or ASTM C 920, Type M, Class 25, Use T.

2.2.8.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C 920, Type M, Grade NS, Class 25, Use T.

2.2.8.3 Joint Sealant Compound

Provide hot-poured, elastic type compound conforming to ASTM D 1190.

2.2.9 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.

2.2.10 Biodegradable Form Release Agent

Provide form release agent that is colorless, biodegradable, and with a low 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.

2.3 REINFORCEMENT

2.3.1 Reinforcing Bars

ACI/MCP-2 unless otherwise specified. Use deformed steel. ASTM A 615/A 615M and AASHTO M 322M/M 322 with the bars marked A, S, W, Grade 60; or ASTM A 996/A 996M with the bars marked R, Grade 60, or marked A, Grade 60.

2.3.2 Wire

ASTM A 82/A 82M or ASTM A 496/A 496M.

2.3.2.1 Welded Wire Fabric

ASTM A 185/A 185M or ASTM A 497/A 497M. Provide flat sheets of welded wire fabric for slabs and toppings.

2.3.3 Reinforcing Bar Supports

Provide bar ties and supports of coated or non corrodible material.

2.3.4 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 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.

2.4 BONDING MATERIALS

2.4.1 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.

2.4.2 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.

2.5 CLASSIFICATION AND QUALITY OF CONCRETE

2.5.1 Concrete Classes and Usage

Provide concrete classes, compressive strength, requirements for air entrainment, and usage as follows:

CONCRETE CLASS	MIN. 28-DAY COMPRESSIVE STRENGTH POUNDS PER SQ. IN.	REQUIREMENT FOR AIR ENTRAINMENT	USAGE
4A	4,000	Air-entrained	For structural concrete work exposed to freezing and thawing, unless otherwise indicated or specified, such as exterior columns and spandrels

2.5.2 Limits for Concrete Proportions

Provide limits for maximum water/cement ratio and minimum cement content for each concrete class as follows:

CONCRETE CLASS	MAX. WATER/CEMENT RATIO BY WEIGHT	MIN. CEMENT FOR 3- TO 4-INCH SLUMP, (NO. OF 94-POUND SACKS) PER CU. YD.
4A	0.46	6.0

* Weight of water to weight of cement in pounds in one cubic yard of concrete

2.5.3 Maximum Size of Aggregate

Size of aggregate, designated by the sieve size on which maximum amount of retained coarse aggregate is 5 to 10 percent by weight, must be as follows:

MAXIMUM SIZE OF AGGREGATE	ASTM C 33 SIZE NUMBER	TYPE OF CONSTRUCTION
3/4 inch	67	Reinforced walls, columns, girders, beams, and other formed sections having a dimension between forms of not less than 6 inches and clear distance between reinforcing bars or reinforcing bar and face of form of not less than 1 inch
3/4 inch	67	Monolithic concrete slabs and other flatwork having a depth of not less than 2-1/2 inches and a clear distance between reinforcing bars of not less

MAXIMUM SIZE OF AGGREGATE	ASTM C 33 SIZE NUMBER	TYPE OF CONSTRUCTION
		than 1 inch
1/2 inch	7	Concrete joist construction, beams, reinforced walls, and other formed work having a clear distance between reinforcing bars and face of form of less than 1 inch

Maximum size of aggregate may be that required for most critical type of construction using that concrete class.

2.5.4 Slump

Provide slump for concrete at time and in location of placement as follows:

TYPE OF CONSTRUCTION	SLUMP
Columns, beams, reinforced walls, monolithic slabs	Not less than 1 inch nor more than 4 inches

2.5.5 Total Air Content

Air content of exposed concrete and interior concrete must be in accordance with ASTM C 260 and/or as follows:

LIMITS CONCRETE EXPOSURE	REQUIREMENT FOR AIR ENTRAINMENT	MAXIMUM SIZE OF AGGREGATE	TOTAL AIR CONTENT BY VOLUME
Exposed to freezing and thawing or subjected to hydraulic pressure	Air-entrained	1-1/2 or 2 inches	4 to 6 percent
		3/4 inch	5 to 7 percent
		1/2 or 3/8 inch	6 to 8.5 percent

Provide concrete exposed to freezing and thawing or subjected to hydraulic pressure that is air-entrained by addition of approved air-entraining admixture to concrete mix.

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 Contracting Officer of unsatisfactory preparation before processing.

Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Contracting

Officer 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, 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 water barrier subgrade cover; 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
Drainage fill	100
Cohesionless soil material	100
Cohesive soil material	95

Finish surface of drainage fill 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 and 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 Reshoring

Reshore concrete elements where forms are removed prior to the specified time period. Do not permit elements to deflect or accept loads during form stripping or reshoring. Forms on columns, walls, or other load-bearing members may be stripped after 2 days if loads are not applied to the members. After forms are removed, reshore slabs and beams over 10 feet in span and cantilevers over 4 feet for the remainder of the specified time period in accordance with paragraph entitled "Removal of Forms." Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Provide reshoring elements with the same load-carrying capabilities as original shoring and spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

3.3.5 Reuse

Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.

3.3.6 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.

3.3.7 Forms for Standard Smooth Form Finish

Give smooth form finish concrete formed surfaces that are to be exposed to view or that are to be covered with coating material applied directly to concrete or with covering material bonded to concrete, such as waterproofing, dampproofing, painting, or other similar coating system.

Form facing material for standard smooth finish must be the specified overlaid concrete form plywood or other approved form facing material that is nonreactive with concrete and that produce concrete surfaces equivalent in smoothness and appearance to that produced by new overlaid concrete form

plywood panels.

Maximum deflection of form facing material between supports and maximum deflection of form supports such as studs and wales must not exceed 0.0025 times the span.

Provide arrangement of form facing sheets that are orderly and symmetrical, and sheets that are in sizes as large as practical.

Arrange panels to make a symmetrical pattern of joints. Horizontal and vertical joints must be solidly backed and butted tight to prevent leakage and fins.

3.3.8 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.

3.3.9 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.

3.3.10 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 Contracting Officer 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.

3.3.10.1 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 FORMED SURFACES

3.4.1 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.

3.4.2 Tolerances

ACI/MCP-4 and as indicated.

3.4.3 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.

3.5 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.

3.5.1 General

Provide details of reinforcement that are in accordance with, and ACI/MCP-4 and as specified.

3.5.2 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.

3.5.3 Splicing

As indicated. For splices not indicated ACI/MCP-2. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches.

3.5.4 Cover

ACI/MCP-2 for minimum coverage, unless otherwise indicated.

3.5.5 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.

3.5.6 Construction Joints

Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.

3.5.7 Expansion Joints and Contraction Joints

Provide expansion joints 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.

3.5.8 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 and ACI/MCP-3.

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.

3.5.9 Placing Reinforcement

Place reinforcement in accordance with 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 Contracting Officer so that conflicts may be reconciled before placing concrete. Anchors and embedded items must be positioned and supported with appropriate accessories.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

Provide supports for reinforcing bars that are sufficient in number and sufficiently heavy to carry the reinforcement they support, and in accordance with ACI/MCP-4 and CRSI 10MSP. Do not use supports to support runways for concrete conveying equipment and similar construction loads.

Equip supports on ground and similar surfaces with sand-plates.

Support welded wire fabric as required for reinforcing bars.

Secure reinforcements to supports by means of tie wire. Wire must be black, soft iron wire, not less than 16 gage.

With the exception of temperature reinforcement, tied to main steel approximately 24 inches on center, reinforcement must be accurately placed, securely tied at intersections with 18-gage annealed wire, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to ACI/MCP-3.

Bending of reinforcing bars partially embedded in concrete is permitted only as specified in and ACI/MCP-4.

3.5.10 Spacing of Reinforcing Bars

Spacing must be as indicated. If not indicated, spacing must be in accordance with the ACI/MCP-3.

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.

3.5.11 Concrete Protection for Reinforcement

Concrete protection must be in accordance with the ACI/MCP-4, ASTM E 648,and ACI/MCP-3.

3.6 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.

3.6.1 Measuring

Make measurements at intervals as specified in paragraphs entitled "Sampling" and "Testing."

3.6.2 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. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 84 degrees F. 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.

3.6.3 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.

3.7 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, consolidation, and finishing; 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.

3.7.1 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.

3.7.2 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width must be a minimum of 4 inches greater than indicated.

3.7.3 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 9,000 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.

3.7.4 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 not 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.

3.7.5 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.

3.7.6 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.

3.7.7 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.

3.7.8 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.

3.7.9 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.

3.7.10 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.

3.8 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.8.1 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.

3.8.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

3.8.3 Formed Surfaces

3.8.3.1 Tolerances

ACI/MCP-1 and as indicated.

3.8.3.2 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.

3.8.3.3 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.

3.8.4 Grout Finish

Provide finish that is standard, smooth coated with grout as specified.

Give finish to interior and exterior concrete vertical surfaces that are to be exposed to view.

Grout is required consisting of one part portland cement to 1-1/2 parts fine aggregate by volume, mixed with water to produce a consistency of thick paint. Portland cement portion must be a blend of standard portland cement and white portland cement, proportioned as determined by trial mixes so that final color of grout when dry approximates color of surrounding concrete. Fine aggregate must pass No. 30 mesh sieve.

Surface of concrete is required to be wetted, and grout must be applied immediately to wetted surfaces. Spread grout over surface with clean burlap pads or sponge-rubber floats to fill pits, air bubbles, and surface holes. Remove excess grout by scraping, then rubbing surface with clean burlap to remove visible grout film. Keep grout damp by means of fog spray

during setting period. Complete finish the day it is started, and make limits of a finished area at natural breaks in finished surface.

3.9 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI/MCP-2, unless otherwise specified. Slope floors uniformly to drains where drains are provided.

3.9.1 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.

3.9.1.1 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.

3.9.1.2 Steel Troweled

Use for floors intended as walking surfaces, and for reception of floor coverings. 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.

3.9.1.3 Nonslip Finish

Use on surfaces of exterior platforms, steps, and landings; and on exterior and interior pedestrian ramps. Apply dry shake aggregate of ceramically bonded aluminum oxide to the surface at a minimum rate of 25 pounds per 100 square feet. Blend approximately two-thirds of the aggregate with portland cement as recommended by the manufacturer and apply to the surface evenly and without segregation. After blended material has been embedded by floating, apply the remainder of the blended material to the surface at right angles to the previous application. Apply blended material heavier in any areas not sufficiently covered by the first application. Perform a second floating immediately following the first. After the selected material has been embedded by the two floatings, complete the operation with a broomed finish.

3.9.1.4 Broomed

Use on surfaces of exterior 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.

3.9.1.5 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 belting. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but gritty nonslip surface is obtained. Round edges and joints with an edger having a radius of 1/8 inch.

3.9.2 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.

3.9.3 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.10 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. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs.

3.10.1 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.

3.10.2 Moist Curing

Remove water without erosion or damage to the structure. Prevent water run-off.

3.10.2.1 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.

3.10.2.2 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.

3.10.2.3 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.

3.10.3 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.

3.10.3.1 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.

3.10.3.2 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.

3.10.4 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.

3.10.5 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 Contracting Officer.

3.10.6 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.

3.10.7 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.

3.10.8 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.

3.10.9 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.

3.10.10 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.

3.10.11 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.11 FIELD QUALITY CONTROL

3.11.1 Sampling

ASTM C 172. Collect samples of fresh concrete to perform tests specified. ASTM C 31/C 31M for making test specimens.

3.11.2 Testing

3.11.2.1 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.

3.11.2.2 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.

3.11.2.3 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.

3.11.2.4 Air Content

ASTM C 173/C 173M or ASTM C 231 for normal weight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.11.2.5 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

3.11.2.6 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 Contracting Officer.

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 Contracting Officer.

3.12 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows.

3.12.1 Mixing Equipment

Before concrete pours, designate Company-owned site meeting environmental standards for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.12.2 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.13 JOINTS

3.13.1 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:

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.

3.13.2 Isolation Joints in Slabs on Ground

Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

Fill joints with premolded joint filler strips 1/2 inch thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 3/4 inch in depth where joint is sealed with sealing compound and not less than 1/4 inch in depth where joint sealing is not required. Remove wood strip after concrete has set. Contractor must clean groove of foreign matter and loose particles after surface has dried.

3.13.3 Contraction Joints in Slabs on Ground

Provide joints to form panels as indicated.

Under and on exact line of each contraction joint, cut 50 percent of welded wire fabric reinforcement before placing concrete.

Joints must be 1/8-inch wide by 1/5 to 1/4 of slab depth and formed by inserting hand-pressed fiberboard strip into fresh concrete until top

surface of strip is flush with slab surface or by cutting the concrete with a saw after the concrete has set. After concrete has cured for at least 7 days, the Contractor must remove inserts and clean groove of foreign matter and loose particles.

3.13.4 Sealing Joints in Slabs on Ground

Isolation and contraction joints which are to receive finish flooring material must be sealed with joint sealing compound after concrete curing period. Slightly underfill groove with joint sealing compound to prevent extrusion of compound. Remove excess material as soon after sealing as possible.

Sealing is not required for isolation and contraction joints to be covered with finish flooring material. Groove must be left ready to receive filling material that is provided as part of finish floor covering work.

3.14 INSTALLATION OF ANCHORAGE DEVICES

3.14.1 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.

3.14.2 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.

3.15 CONCRETE CONVEYING

3.15.1 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.

3.15.2 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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PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION

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.

ALUMINUM ASSOCIATION (AA)

AA H35.1/35.1M	(2009) Alloy and Temper Designation Systems for Aluminum

ACI INTERNATIONAL (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 211.2	(1998; R 2004) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 305R	(1999; Errata 2006) Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 318	(2008; Errata 2008; Errata 2009; Errata 2009; Errata 2009; Errata 2009; Errata 2009) Building Code Requirements for Structural Concrete and Commentary

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-102	(2000) Concrete Pipe Handbook
ACPA 01-110	(1984) Design Manual for Sulfide and Corrosion Prediction and Control
ACPA QPC	(2005; Ver 3.0) QCast Plant Certification Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2008; Errata 2009) Structural Welding Code - Steel
AWS D1.4/D1.4M	(2005; Errata 2005) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 615/A 615M	(2009) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 82/A 82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM C 1064/C 1064M	(2008) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C 1107/C 1107M	(2008) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1116/C 1116M	(2008a) Standard Specification for Fiber-Reinforced Concrete
ASTM C 1240	(2005) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C 1244	(2005e1) Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
ASTM C 138/C 138M	(2009) Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete
ASTM C 143/C 143M	(2009) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 1478	(2008) Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes and Laterals
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete

ASTM C 173/C 173M	(2009) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(2007) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(2009a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2009) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 330	(2005) Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C 39/C 39M	(2005e1e2) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 443	(2005a) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 494/C 494M	(2008a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 595/C 595M	(2008a) Standard Specification for Blended Hydraulic Cements
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 877	(2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C 891	(1990; R 2003) Installation of Underground Precast Concrete Utility Structures
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM C 923	(2008) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and

	Laterals
ASTM C 972	(2000; R 2006) Compression-Recovery of Tape Sealant
ASTM C 989	(2009a) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D 412	(2006ae1e2) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 624	(2000; R 2007) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

CANADIAN STANDARDS ASSOCIATION (CSA)

CAN/CSA A23.4	(2005) Precast Concrete - Materials and Construction

NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA)

NPCA QC Manual	(2005; R 2006) Quality Control Manual for Precast Plants

1.2 SYSTEM DESCRIPTION

Furnish precast concrete units designed and fabricated by an experienced and acceptable precast concrete manufacturer who has been, for at least 3 years, regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings. Coordinate precast work with the work of other trades.

1.2.1 Standard Precast Units

Design standard precast concrete units to withstand indicated design load conditions in accordance with applicable industry design standards. Design shall also consider stresses induced during handling, shipping and installation as to avoid product cracking or other handling damage. Indicate design loads for precast concrete units on the shop drawings.

1.2.2 Custom-Made Precast Units

Precast unit dimensions shall be as indicated. Construct precast units with reinforced concrete as indicated. The top of the precast valve vault shall be a raised frame solid plate cover conforming to AA H35.1/35.1M. Design concrete cover to support the anticipated loadings no less than 250 psf.

Submit design calculations and drawings of custom-made precast units, prepared and sealed by a registered professional engineer, for approval prior to fabrication. Include in the calculations the analysis of units

for lifting stresses and the sizing of lifting devices.

1.2.3 Proprietary Precast Units

Products manufactured under franchise arrangements shall conform to all the requirements specified by the franchiser. Items not included in the franchise specification, but included in this specification, shall conform to the requirements in this specification.

1.2.4 Joints and Sealants

Provide joints and sealants between adjacent units of the type and configuration indicated on shop drawings meeting specified design and performance requirements.

1.2.5 Concrete Mix Design

1.2.5.1 Concrete Mix Proportions

Base selection of proportions for concrete on the methodology presented in ACI 211.1 for normal weight concrete and ACI 211.2 for lightweight concrete. Develop the concrete proportions using the same type and brand of cement, the same type and brand of pozzolan, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for the project. Do not use calcium chloride in precast concrete containing reinforcing steel or other embedded metal items. At a minimum of thirty days prior to precast concrete unit manufacturing, the precast concrete producer will submit a mix design for each strength and type of concrete that will be used. Furnish a complete list of materials, including quantity, type, brand and applicable data sheets for all mix design constituents as well as applicable reference specifications. The use of self-consolidating concrete is permitted, provided that mix design proportions and constituents meet the requirements of this specification.

1.2.5.2 Concrete Strength

Provide precast concrete units with a 28-day compressive strength (f'c) of 5000 psi.

1.2.5.3 Water-to-Cement Ratio

Furnish concrete, that will be exposed to freezing and thawing, containing entrained air and with water-cement ratios of 0.45 or less. Furnish concrete which will not be exposed to freezing, but which is required to be watertight, with a water-cement ratio of 0.48 or less if the concrete is exposed to fresh water, or 0.45 or less if exposed to brackish water or sea water. Furnish reinforced concrete exposed to deicer salts, brackish water or seawater with a water-cement ratio of 0.40 or less for corrosion protection.

1.2.5.4 Air Content

The air content of concrete that will be exposed to freezing conditions shall be within the limits given below.

NOMINAL MAXIMUM AGGREGATE SIZE	AIR CONTENT % SEVERE EXPOSURE	MODERATE EXPOSURE
10 mm (3/8 inch)	6.0 to 9.0	4.5 to 7.5
13 mm (1/2 inch)	5.5 to 8.5	4.0 to 7.0
19 mm (3/4 inch)	4.5 to 7.5	3.5 to 6.5
25 mm (1.0 inch)	4.5 to 7.5	3.0 to 6.0
38 mm (1.5 inch)	4.5 to 7.0	3.0 to 6.0

Note: For specified compressive strengths greater than 5000 psi, air content may be reduced 1 percent

1.2.5.5 Corrosion Control for Sanitary Sewer Systems

Follow design recommendations outlined in Chapter 7 of ACPA 01-102 or the ACPA 01-110 when hydrogen sulfide is indicated as a potential problem.

1.3 SUBMITTALS

All submittals are the responsibility of the precast concrete producer. Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Procedures

Quality control procedures established by the precast manufacturer in accordance with NPCA QC Manual and/or ACPA QPC.

SD-02 Shop Drawings

Standard Precast Units; G

Drawings for standard precast concrete units furnished by the precast concrete producer for approval by the Contracting Officer. These drawings shall demonstrate that the applicable industry design standards have been met. Include installation and construction information on shop drawings. Include details of steel reinforcement size and placement as well as supporting design calculations, if appropriate. Produce precast concrete units in accordance with the approved drawings.

Custom-Made Precast Units; G

Drawings for custom-made precast concrete units furnished by the precast concrete producer for approval by the Contracting Officer. Show on these drawings complete design, installation, and construction information in such detail as to enable the Contracting Officer to determine the adequacy of the proposed units for the intended purpose. Include details of steel reinforcement size and placement as well as supporting design calculations, if appropriate. Produce precast concrete units in accordance with the approved drawings.

SD-03 Product Data

Standard Precast Units

Cut sheets, for standard precast concrete units, showing conformance to project drawings and requirements, and to applicable industry design standards listed in this specification.

Proprietary Precast Units

Standard plans or informative literature, for proprietary precast concrete units. Make available supporting calculations and design details upon request. Provide sufficient information as to demonstrate that such products will perform the intended task.

Embedded Items

Product data sheets and proper installation instruction for anchors, lifting inserts and other devices. Clearly indicate the products dimensions and safe working load.

Accessories

Proper installation instructions and relevant product data for items including, but not limited to, sealants, gaskets, connectors, steps, cable racks and other items installed before or after delivery.

SD-05 Design Data

Design Calculations
Concrete Mix Proportions

Precast concrete unit design calculations, and concrete mix proportions.

SD-06 Test Reports

Test Reports

Test reports and documentation to demonstrate compliance with the specifications.

SD-07 Certificates

Quality Control Procedures

Quality control procedures established in accordance with NPCA QC Manual and/or ACPA QPC.

1.4 QUALITY ASSURANCE

Demonstrate adherence to the standards set forth in NPCA QC Manual and/or ACPA QPC. Meet requirements written in the subparagraphs below.

1.4.1 NPCA and ACPA Plant Certification

The precast concrete producer shall be certified by the National Precast Concrete Association's and/or the American Concrete Pipe Association's

Plant Certification Program prior to and during production of the products for this project.

1.4.2 Qualifications, Quality Control and Inspection

1.4.2.1 Qualifications

Select a precast concrete producer that has been in the business of producing precast concrete units similar to those specified for a minimum of 3 years. The precast concrete producer shall maintain a permanent quality control department or retain an independent testing agency on a continuing basis.

1.4.2.2 Quality Control Procedures

Show that the following QC tests are performed as required and in accordance with the ASTM standards indicated.

a. Slump: Perform a slump test for each 150 cu yd of concrete produced, or once a day, whichever comes first. Perform slump tests in accordance with ASTM C 143/C 143M.

b. Temperature: Measure the temperature of fresh concrete when slump or air content tests are made and when compressive test specimens are made in accordance with ASTM C 1064/C 1064M.

c. Compressive Strength: Make at least four compressive strength specimens for each 150 cubic yards of concrete of each mix in accordance with the following Standards: ASTM C 31/C 31M, ASTM C 192/C 192M, ASTM C 39/C 39M.

d. Air Content: Perform tests for air content on air-entrained, wet-cast concrete for each 150 cu yd of concrete, but not less often than once each day when air-entrained concrete is used. Determine the air content in accordance with either ASTM C 231 or ASTM C 173/C 173M for normal weight aggregates and ASTM C 173/C 173M for lightweight aggregates.

e. Unit Weight: Perform tests for unit weight a minimum of once per week to verify the yield of batch mixes. Perform unit weight tests for each 100 cu yd of lightweight concrete in accordance with ASTM C 138/C 138M.

Submit test reports as Follows:

a. Copies of material certifications and/or laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolans, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

b. Copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Such tests may include compressive strength, flexural strength, plastic or hardened air content, freeze thaw durability, abrasion and absorption. Clearly detail in the specifications special tests for precast concrete or cast-in items.

c. Sufficient documentation, when the use of self-consolidating concrete (SCC) is proposed, showing a minimum of 30-days production track records demonstrating that SCC is appropriate for casting of the product.

d. Copies of in-plant QA/QC inspection reports, upon the request of the Contracting Officer.

1.4.2.3 Inspection

The Contracting Officer may place an inspector in the plant when the units covered by this specification are being manufactured. The precast concrete producer shall give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver precast units to the site in accordance with the delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite, all precast concrete units will be inspected by the Contracting Officer for quality and final acceptance.

1.5.2 Storage

Store units off the ground or in a manner that will minimize potential damage.

1.5.3 Handling

Handle, transport, and store products in a manner to minimize damage. Lifting devices or holes shall be consistent with industry standards. Perform lifting with methods or devices intended for this purpose as indicated on shop drawings.

PART 2 PRODUCTS

2.1 MATERIALS

Except as otherwise specified in the following paragraphs, conform materials to Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.1.1 Cement

Furnish cement conforming to ASTM C 150/C 150M, Type I, II, III or V. Furnish blended cements that conform to ASTM C 595/C 595M.

2.1.2 Silica Fume

Provide silica fume conforming to ASTM C 1240. Provide available alkalies conforming to the optimal limit given in Table 2 of ASTM C 1240. Silica fume may be furnished as a dry, densified material or as a slurry. When necessary, coordinate the services of a technical representative experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume.

2.1.3 Fly Ash and Pozzolans

Fly ash is used as an admixture conforming to ASTM C 618, Class C or F with 4 percent maximum loss on ignition and 35 percent maximum cement replacement by weight.

2.1.4 Ground Granulated Blast-Furnace Slag

Ground granulated blast furnace slag is used as an admixture conforming to ASTM C 989, Grade 120 with between 25 to 50 percent maximum cement replacement by weight.

2.1.5 Water

Furnish water potable or free of deleterious substances in amounts harmful to concrete or embedded metals.

2.1.6 Aggregates

2.1.6.1 Selection

Furnish aggregates conforming to ASTM C 33/C 33M. Provide aggregates not containing any substance, which may be deleteriously reactive with the alkalies in the cement.

2.1.6.2 Aggregates for Lightweight Concrete

ASTM C 330

2.1.7 Admixtures

2.1.7.1 Air-Entraining

ASTM C 260

2.1.7.2 Accelerating, Retarding, Water Reducing

ASTM C 494/C 494M

2.1.8 Reinforcement

2.1.8.1 Reinforcing Bars

a. Deformed Billet-steel: ASTM A 615/A 615M

2.1.8.2 Reinforcing Wire

a. Plain Wire: ASTM A 82/A 82M

2.1.8.3 Welded Wire Fabric

a. Plain Wire: ASTM A 185/A 185M

2.1.9 Synthetic Fiber Reinforcement

Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of 2 inch.

2.1.10 Inserts and Embedded Metal

All items embedded in concrete shall be of the type required for the intended task, and meet the following standards.

a. Structural Steel Plates, Angles, etc.: ASTM A 36/A 36M
b. Hot-dipped Galvanized: ASTM A 153/A 153M
c. Proprietary Items: In accordance with manufacturers published literature

2.1.11 Accessories

a. Rubber Gaskets for Circular Concrete Sewer Pipe and Culvert Pipe: ASTM C 443.

b. External Sealing Bands for Noncircular Sewer, Storm Drain and Culvert Pipe: ASTM C 877.

c. Preformed Flexible Joint Sealants for Concrete Pipe, Manholes, and Manufactured Box Sections: ASTM C 990.

d. Elastomeric Joint Sealants: ASTM C 920

e. Valve Vault Pipe Sleeves: Provide pipe sleeves of sufficient length to pass through valve vault. Pipe sleeves shall be zinc-coated steel pipe conforming to the requirements of ASTM A 53/A 53M, Schedule 40 or standard weight. Secure the pipe sleeves in the proper position and location during construction of the valve manhole. Select the space between the sleeve and the pipe casing, and the caulking and sealing materials so there shall be no electrical continuity between the pipe sleeve and the pipe casing when finished.

f. Rubber Annular Hydrostatic Sealing Devices: Provide rubber annular hydrostatic sealing devices of the modular mechanical type, using interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe sleeve and the passing pipe. Assemble links to form a continuous rubber belt around the pipe, with a pressure plate under each bolthead and nut.

Provide materials of construction as follows:

Compound	Material
Pressure plate	Composite glass-reinforced nylon
Bolts and nuts for links	Type 303 or 316 stainless steel
Sealing element	EPDM rubber

Ensure that the size of the wall sleeve needed to accommodate the passing pipe is as recommended by the rubber annular seal manufacturer.

Provide entering blocks in 25 percent of the sealing elements on pipelines larger than 12 inches in diameter.

Provide Link Seal rubber annular hydrostatic sealing devices as manufactured by Thunderline Corporation, Innerlynx as manufactured by Advance Products & Systems, Inc., or approved equal.

2.1.12 Pipe Entry Connectors

Pipe entry connectors shall conform to ASTM C 923 or ASTM C 1478.

2.1.13 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. The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Propylene Di 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, pi	ASTM D 624 (Die B)	280	160	-
Rebound, percent, 5 minutes	ASTM C 972 (mod.)	-	-	11
Rebound, percent, 2 hours	ASTM C 972	-	-	12

2.1.14 Grout

Nonshrink Grout shall conform to ASTM C 1107/C 1107M. Cementitious grout shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

PART 3 EXECUTION

3.1 FABRICATION AND PLACEMENT

Perform fabrication in accordance with NPCA QC Manual and/or ACPA QPC unless specified otherwise.

3.1.1 Forms

Use forms, for manufacturing precast concrete products, of the type and design consistent with industry standards and practices. They should be capable of consistently providing uniform products and dimensions. Construct forms so that the forces and vibrations to which the forms will be subjected can cause no product damage. Clean forms of concrete build-up

after each use. Apply form release agents according to the manufacturers recommendations and do not allow to build up on the form casting surfaces.

3.1.2 Reinforcement

Follow applicable ASTM Standard or ACI 318 for placement and splicing. Fabricate cages of reinforcement either by tying the bars, wires or welded wire fabric into rigid assemblies or by welding, where permissible, in accordance with AWS D1.4/D1.4M. Position reinforcing as specified by the design and so that the concrete cover conforms to requirements. The tolerance on concrete cover shall be one-third of that specified but not more than 1/2 inch. Provide concrete cover not less than 1/2 inch. Take positive means to assure that the reinforcement does not move significantly during the casting operations.

3.1.3 Embedded Items

Position embedded items at locations specified in the design documents. Perform welding in accordance with AWS D1.1/D1.1M when necessary. Hold rigidly in place inserts, plates, weldments, lifting devices and other items to be imbedded in precast concrete products so that they do not move significantly during casting operations.

3.1.4 Synthetic Fiber Reinforced Concrete

Add fiber reinforcement to the concrete mix in accordance with the applicable sections of ASTM C 1116/C 1116M and the recommendations of the manufacturer, and in an amount of 0.1 percent by volume.

3.2 CONCRETE

3.2.1 Concrete Mixing

Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

3.2.2 Concrete Placing

Deposit concrete into forms as near to its final location as practical. Keep the free fall of the concrete to a minimum. Consolidate concrete in such a manner that segregation of the concrete is minimized and honeycombed areas are kept to a minimum. Use vibrators to consolidate concrete with frequencies and amplitudes sufficient to produce well consolidated concrete.

3.2.2.1 Cold Weather Concreting

Perform cold weather concreting in accordance with ACI 306.1.

a. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather.

b. Free from frost all concrete materials and all reinforcement, forms, fillers, and ground with which concrete is to come in contact.

c. Do not use frozen materials or materials containing ice.

d. In cold weather the temperature of concrete at the time of placing shall not be below 45 degrees F. Discard concrete that freezes before its compressive strength reaches 500 psi.

3.2.2.2 Hot Weather Concreting

Recommendations for hot weather concreting are given in detail in ACI 305R. During hot weather, give proper attention to constituents, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that could impair required strength or serviceability of the member or structure. The temperature of concrete at the time of placing shall not exceed 90 degrees F.

3.2.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing.

3.2.3.1 Curing by Moisture Retention

Prevent moisture evaporation from exposed surfaces until adequate strength for stripping is reached by one of the following methods:

a. Cover with polyethylene sheets a minimum of 6 mils thick in accordance with ASTM C 171.

b. Cover with burlap or other absorptive material and keep continually moist.

c. Use of a membrane-curing compound applied at a rate not to exceed 200 square ft/gallon, or in accordance with manufacturers' recommendations according to ASTM C 309.

3.2.3.2 Curing with Heat and Moisture

Do not subject concrete to steam or hot air until after the concrete has attained its initial set. Apply steam, if used, within a suitable enclosure, which permits free circulation of the steam in accordance with CAN/CSA A23.4. If hot air is used for curing, take precautions to prevent moisture loss from the concrete. The temperature of the concrete shall not be permitted to exceed 150 degrees F. These requirements do not apply to products cured with steam under pressure in an autoclave.

3.2.4 Surface Finish

Finish unformed surfaces of wet-cast precast concrete products as specified. If no finishing procedure is specified, finish such surfaces using a strike-off to level the concrete with the top of the form.

3.2.4.1 Formed Non-Architectural Surfaces

Cast surfaces against approved forms following industry practices in cleaning forms, designing concrete mixes, placing and curing concrete. Normal color variations, form joint marks, small surface holes caused by air bubbles, and minor chips and spalls will be accepted but no major imperfections, honeycombs or other major defects will be permitted.

3.2.4.2 Unformed Surfaces

Finish unformed surfaces with a vibrating screed, or by hand with a float. Normal color variations, minor indentations, minor chips and spalls will be accepted but no major imperfections, honeycombs, or other major defects

shall be permitted.

3.2.4.3 Special Finishes

Troweled, broom or other finishes shall be according to the requirements of project documents and performed in accordance with industry standards or supplier specifications. Submit finishes for approval when required by the project documents. The sample finishes shall be approved prior to the start of production.

3.2.5 Stripping Products from Forms

Do not remove products from the forms until the concrete reaches the compressive strength for stripping required by the design. If no such requirement exists, products may be removed from the forms after the final set of concrete provided that stripping damage is minimal.

3.2.6 Patching and Repair

No repair is required to formed surfaces that are relatively free of air voids and honeycombed areas, unless the surfaces are required by the design to be finished.

3.2.6.1 Repairing Minor Defects

Defects that will not impair the functional use or expected life of a precast concrete product may be repaired by any method that does not impair the product.

3.2.6.2 Repairing Honeycombed Areas

When honeycombed areas are to be repaired, remove all loose material and cut back the areas into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged. Use proprietary repair materials in accordance with the manufacturer's instructions. If a proprietary repair material is not used, saturate the area with water. Immediately prior to repair, the area should be damp, but free of excess water. Apply a cement-sand grout or an approved bonding agent to the chipped surfaces, followed immediately by consolidating an appropriate repair material into the cavity.

3.2.6.3 Repairing Major Defects

Evaluate, by qualified personnel, defects in precast concrete products which impair the functional use or the expected life of products to determine if repairs are feasible and, if so, to establish the repair procedure.

3.2.7 Shipping Products

Do not ship products until they are at least 5 days old, unless it can be shown that the concrete strength has reached at least 75 percent of the specified 28-day strength, or that damage will not result, impairing the performance of the product.

3.3 INSTALLATION

3.3.1 Site Access

It is the Contractor's responsibility to provide adequate access to the site to facilitate hauling, storage and proper handling of the precast concrete products.

3.3.2 General Requirements

a. Install precast concrete products to the lines and grades shown in the contract documents or otherwise specified.

b. Lift products by suitable lifting devices at points provided by the precast concrete producer.

c. Install products in accordance with the precast concrete producer's instructions. In the absence of such instructions, install underground utility structures in accordance with ASTM C 891. Install pipe and manhole sections in accordance with the procedures outlined by the American Concrete Pipe Association.

d. Field modifications to the product will relieve the precast producer of liability even if such modifications result in the failure of the product.

3.3.3 Manhole Installation

Construct manholes to the dimensions shown on the drawings and as specified in this Section. Protect all work against flooding and flotation.

Place the manhole base on a bed of 12-inch crushed stone as shown on the drawings. Minimum diameter of the stone foundation shall be the outside diameter of the base plus 2 feet. Set the manhole base grade so that a maximum grade adjustment of 12 inches is required to bring the manhole frame and cover to final grade.

Use precast concrete grade rings or brick and nonshrink mortar to adjust the manhole frame and cover to final grade.

Set precast concrete manhole sections plumb with a 1/4-inch maximum out-of-plumb tolerance allowed. Seal joints of precast barrel sections with either a rubber O-ring set in a recess or preformed flexible joint sealant in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with nonshrink mortar and finish flush with the adjoining surfaces. Caulk the inside of any leaking barrel section joint with lead wool or nonshrink grout to the satisfaction of the Contracting Officer.

Allow joints to set for 14 hours before backfilling unless the Contracting Officer specifically approves a shorter period.

Plug holes in the concrete barrel sections required for handling with a nonshrinking grout or nonshrinking grout in combination with concrete plugs. Finish flush on the inside.

The ends of the pipe shall be accurately positioned in the openings and properly secured against movement.

Backfill carefully and evenly around manhole sections.

3.3.3.1 Manhole Pipe Connections

Construct manhole pipe connections, including pipe stubs, as specified above. Close or seal pipe stubs for future connections with a gasketed watertight plug.

3.3.3.2 Mortar

Mix mortar only in such quantity as may be required for immediate use. Use mortar before initial set has taken place. Use mortar within 1-1/2 hours and constantly work with hoe or shovel until used. Do not include antifreeze mixtures in the mortar. Install masonry when the outside temperature is above 40 degrees F unless provisions are made to protect the mortar and finished work from frost by heating and enclosing the work with tarpaulins or other suitable material. The Contracting Officer's decision regarding the adequacy of protection against freezing shall be final.

3.3.3.3 Setting Manhole Frame and Cover

Set manhole covers and frames in a full mortar bed so that the space between the top of the manhole masonry and the bottom flanges of the frame will be completely filled and made watertight. Use precast concrete grade rings a maximum of 12 inches thick to ensure that the frame and cover are set to the finished grade. Set the manhole frame and cover to final grade before placing permanent paving. Install curb inlet stones as shown on the drawings.

Set manhole frames and covers flush with finish pavement or 3 inches above the finished grade in unpaved areas. Place a ring of mortar around the outside of the bottom flange at least 1 inch thick and pitched to shed water away from the frame. Extend mortar to the outer edge of the masonry and finish smooth and flush with the top of the flange.

3.3.3.4 Dampproofing

Paint outer surfaces of manholes with two coats of bituminous dampproofing at the rate of 30 to 60 square feet per gallon, in accordance with the manufacturer's instructions.

3.3.4 Water Tightness

Where water tightness is a necessary performance characteristic of the precast concrete product's end use, watertight joints, connectors and inserts should be used to ensure the integrity of the entire system.

3.4 LEAKAGE TESTS

Test each sewer manhole and wetwell for leakage by one of the methods described below. The Contracting Officer shall observe each test.

3.4.1 Exfiltration Test

Assemble precast structure in place; fill and point all lifting holes and exterior joints within 6 feet of the ground surface with an approved non-shrinking mortar. Test before placing the shelf and invert and before filling and pointing the horizontal joints below 6 feet of depth. Lower the groundwater table below the bottom of the structure for the duration of

the test. Plug all pipes and other openings into the precast structures and brace to prevent blow out.

Fill the manhole with water to the top of the structure. If the excavation has not been backfilled and no water is observed moving down the surface of the structure, the manhole is satisfactorily watertight. If the test as described above is unsatisfactory as determined by the Contracting Officer or if the excavation has been backfilled, continue the test. A period of time may be permitted to allow for absorption. Following this period, refill the manhole to the top of the structure, if necessary, and wait at least 8 hours. At the end of the test period, refill the manhole to the top of the structure again, measuring the volume of water added. Extrapolate the refill amount to a 24-hour leakage rate. Ensure that the leakage for each manhole does not exceed 1 gallon per vertical foot for a 24-hour period. If the manhole fails this requirement, but the leakage does not exceed 3 gallons per vertical foot per day, the Contractor may make repairs by approved methods as directed by the Contracting Officer. If leakage due to a defective section of joint exceeds 3 gallons per vertical foot per day, the structure shall be rejected. Uncover the rejected structure as necessary to disassemble, reconstruct, or replace it as directed by the Contracting Officer. Retest the manhole and, if satisfactory, fill and paint the interior joints.

No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete.

3.4.2 Infiltration Test

An infiltration test may be substituted for an exfiltration test if the groundwater table is above the highest joint in the manhole. If the Contracting Officer determines there is no leakage into the manhole, the manhole will be considered watertight. If the Contracting Officer is not satisfied, the Contractor shall perform an exfiltration or air testing.

3.4.3 Vacuum Test

Vacuum testing shall conform to ASTM C 1244.

If the pressure drop exceeds the acceptable limits, the Contractor will be allowed to make necessary repairs, as approved by the Contracting Officer. Then retest the manhole.

When a successful vacuum test has been completed, fill and point the interior and exterior joints.

-- End of Section --

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DIVISION 05 - METALS

SECTION 05 50 13

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MISCELLANEOUS METAL FABRICATIONS

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.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2008; Errata 2009) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.2	(1987; R 2005) Standard for Square and Hex Nuts
ASME B18.21.1	(1999; R 2005) Lock Washers (Inch Series)
ASME B18.22.1	(1965; R 2008) Plain Washers

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A 467/A 467M	(2007) Standard Specification for Machine Coil and Chain
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 653/A 653M	(2009) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 687	(1993) Standard Specification for High-Strength Nonheaded Steel Bolts and Studs
ASTM A 780/A 780M	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 924/A 924M	(2009) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM D 1187	(1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E 488	(1996; R 2003) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	(2004; E 2004) Power Tool Cleaning
SSPC SP 6	(2007) Commercial Blast Cleaning

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Access doors and panels, installation drawings; G

SD-03 Product Data

Access doors and panels

1.3 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.

1.4 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 A 36/A 36M.

2.1.2 Steel Pipe

ASTM A 53/A 53M, Type E or S, Grade B.

2.1.3 Anchor Bolts

2.1.3.1 Expansion Anchors, Sleeve Anchors, and Adhesive Anchors

Provide 3/4-inch diameter expansion anchors, sleeve anchors, or adhesive anchors as indicated on the drawings. Minimum concrete embedment shall be as indicated on the drawings. Design values listed shall be as tested according to ASTM E 488.

a. Minimum allowable pullout value shall be 4000lb.

b. Minimum allowable shear value shall be 5000lb.

2.1.3.2 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 and ASTM A 687 or ASTM A 307.

2.1.3.3 Washers

Provide plain washers to conform to ASME B18.22.1. 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 A 123/A 123M, ASTM A 153/A 153M, ASTM A 653/A 653M or ASTM A 924/A 924M, 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 A 780/A 780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. 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.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative applied in the shop.

2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.3 ACCESS DOORS AND PANELS

Provide flush type access doors and panels unless otherwise indicated. Fabricate frames for access doors of steel not lighter than 14 gage with welded joints and anchorage for securing into construction. Provide access doors with a minimum of 14 by 20 inches or as indicated in drawings and of not lighter than 14 gage steel, with stiffened edges and welded attachments. Provide access doors hinged to frame and with a flush-face, turn-screw-operated latch. Provide exposed metal surfaces with a shop applied prime coat. Design access door to withstand a minimum of 250 psf live load with maximum deflection of L/240.

2.4 GUARD POSTS (BOLLARDS/PIPE GUARDS)

Provide 6-inch galvanized standard weight steel pipe as specified in ASTM A 53/A 53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 2500 psi.

2.5 MISCELLANEOUS PLATES AND SHAPES

Provide for items that do not form a part of the structural steel framework, such as lintels, sill angles, support framing for ceiling-mounted toilet partitions, miscellaneous mountings and frames. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as indicated and as required to support wall loads over openings. Provide with connections and fasteners. Construct to have at least 8 inches bearing on masonry at each end.

Provide angles and plates, ASTM A 36/A 36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A 123/A 123M.

2.6 SAFETY CHAINS

Construct safety chains of galvanized steel, straight link type, 3/16 inch diameter, with at least twelve links per foot, and with snap hooks on each end. Test safety chain in accordance with ASTM A 467/A 467M, Class CS.

Provide snap hooks of boat type. Provide galvanized 3/8 inch bolt with 3/4 inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, 4 inches longer than the anchorage spacing, for each guarded area. Locate safety chain where indicated. Mount the top chain 3 feet 6 inches above the floor and mount the lower chain 2 feet above the floor.

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 ground 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; toggle bolts and through bolts for masonry; 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 coat conforming to MPI 79 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.

3.6.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

3.6.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer.

3.7 ACCESS PANELS

Install a removable access panel not less than 12 by 12 inches directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

3.8 INSTALLATION OF GUARD POSTS (BOLLARDS/PIPE GUARDS)

Set pipe guards vertically in concrete piers. Construct piers of, and the hollow cores of the pipe filled with, concrete having a compressive strength of 3000 psi.

3.9 MOUNTING OF SAFETY CHAINS

Mount safety chains 3 feet 6 inches and 2 feet above the floor.

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PAINTING AND COATING

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 C 920	(2008) Standard Specification for Elastomeric Joint Sealants

MASTER PAINTERS INSTITUTE (MPI)

MPI 3	Primer, Alkali Resistant, Water Based
MPI 4	(Jan 2004) Interior/Exterior Latex Block Filler
MPI 5	(Jan 2004) Exterior Alkyd Wood Primer
MPI 10	(Jan 2004) Exterior Latex, Flat, MPI Gloss Level 1
MPI 46	(Jan 2004) Interior Enamel Undercoat
MPI 47	(Jan 2004) Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
MPI 50	(Jan 2004) Interior Latex Primer Sealer
MPI 54	(Jan 2004) Interior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer
MPI 80	Primer, Vinyl Wash
MPI 115	(Jan 2004) Epoxy-Modified Latex, Interior, Gloss (MPI Gloss Level 6)

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	(2004; E 2004) Power Tool Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

MS DOD-P-15328	(1991d) Primer (Wash), Pretreatment (Formula No. 117 for Metals)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	(Rev B; Am 1) Colors Used in Government Procurement
FS A-A-1500	Performance Alternates
FS TT-E-508	Enamel, Interior, Semi-Gloss, Tints and White
FS TT-E-509	Enamel, Odorless, Alkyd, Interior Semi-Gloss, White and Tint
FS TT-P-19	(1985; Rev D) Paint, Latex, (Acrylic Emulsion, Exterior Wood and Masonry)
FS TT-P-25	Primer Coating, Exterior, Alkyd, Undercoat for Wood
FS TT-P-102	(Rev F) Paint, Oil, (Alkyd Modified, Exterior, Low VOC)
FS TT-P-650	(Rev D) Primer Coating, Latex Base, Interior, White (for Gypsum Wallboard, or Plaster)
FS TT-P-664	(Rev D) Lacquer-Resisting L&C Free Alkyd Primer
FS TT-P-1511	Paint, Latex Exterior - Gloss and Semi-Gloss
FS TT-S-223	Floor Sealant, Water Emulsion

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material Safety Data Sheets shall be submitted to the Contracting Officer.

Manufacturer's Standard Color Charts shall be submitted for architectural painting materials in accordance with the paragraph entitled, "General," of this section.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items including designated name, formula or specification number, manufacturer's instructions and name of manufacturer. Data shall include detailed analysis of each coating material required, with constituents measured as percentages of the total weight of coating; and details of application, thinning, and average coverage per gallon.

Caulk/Sealer
Inhibitive Metal Primer
Wash Primer
Pigmented Primer/Sealer
Latex Block Filler
Masonry Primer/Sealer
Enamel
Wood Primer
Acrylic Latex
Acrylic Epoxy

1.3 DELIVERY, HANDLING AND STORAGE

Materials shall be delivered in their original, unbroken containers bearing the manufacturer's name and product identification.

All paint materials, thinners, and cleaners shall be stored in tightly closed containers in a covered, well-ventilated area where they will not be exposed to excessive heat, sparks, flame, or direct sunlight. Water-based materials shall be protected against freezing.

Material Safety Data Sheets shall be submitted by the Contracting Officer.

1.4 CONTRACTOR PERSONNEL QUALIFICATION

Personnel assigned to the work shall be certified by the Contractor to have had adequate previous experience in the successful application of paints and coatings similar to those specified.

1.5 WARRANTY

Contractor shall guarantee all work against defects in labor and material for a period of one year.

PART 2 PRODUCTS

2.1 GENERAL

The following are suggested paint manufacturers and their products. Other paint manufacturers' products of equal quality will be considered when approved by the Contracting Officer. All thinners and cleaners shall be products of the coating manufacturer. Primer and finish coats of the paint system shall be products of the same manufacturer.

Manufacturer's Standard Color Charts shall be submitted for architectural painting Materials showing manufacturer's recommended finish colors. Three color chips of each color and gloss scheduled shall also be submitted.

2.2 EXTERIOR PRODUCTS

	FEDERAL SPECIFICATION	PITTSBURGH	SHERWIN WILLIAMS	ICI / GLIDDEN
Caulk/Sealer	ASTM C 920	Chem Calk	Elastomeric	--
Latex Block Filler, MPI 4	FS A-A-1500	6-15	B25W25	4000
Masonry Primer/Sealer,	FS TT-S-223	6-14	A 24W300	3030

MPI 3	FEDERAL SPECIFICATION	PITTSBURGH	SHERWIN WILLIAMS	ICI / GLIDDEN
Enamel	FS TT-P-102	1-934	A-2	2518
Wood Primer, MPI 5	FS TT-P-25	6-9	Y24W20	2110
Inhibitive Metal Primer, MPI 79	FS TT-P-664 FS TT-P-664	--	B50NN26 B50W21	4160
Acrylic Latex flat emulsion, MPI 10	FS TT-P-19	72-110	A6W16 B36WB10	2200 2210
Wash Primer, MPI 80	MS DOD-P-15328	97-687/8	P-60G2	--

2.3 INTERIOR PRODUCTS

	FEDERAL SPECIFICATION	PITTSBURGH	SHERWIN WILLIAMS	ICI / GLIDDEN
Latex Block Filler, MPI 4	FS A-A-1500	6-15	B25W25	4000
Masonry Primer/Sealer, MPI 3	FS TT-S-223	6-14	A24W300	4130 6100
Wood Primer, MPI 46	FS TT-P-25	6-6	B49	1120 1110
Inhibitive Metal Primer, MPI 79	FS TT-P-664 FS TT-P-664	--	B50NN26 B50W21	4100 4160
Pigmented Primer/Sealer, MPI 50	FS TT-P-650	6-2	B28WQ8001 B28W400	1000 1030
Enamel, MPI 47	FS TT-E-508 FS TT-E-509	6-110	B34W251	1507
Acrylic Latex, MPI 54	FS TT-P-1511	6-500	B48 Series	1406 1407
Water-base Acrylic Epoxy, MPI 115	--	98-1/98-9	B70 W Series	4418 4408

PART 3 EXECUTION

3.1 GENERAL

Manufacturer's recommendations for surface preparation, thinning, mixing, handling, and applying his product shall be considered a part of this specification. In case of conflict between the manufacturer's recommendations and the requirements of this specification, the latter shall take precedence.

3.2 PROTECTION

Contractor shall remove and reinstall, or provide acceptable protection for, all hardware, accessories, lighting and electrical components,

factory-finished materials, plumbing fixtures and fittings, and any other materials that may become splattered or damaged by the painting work. "WET PAINT" signs shall be posted to indicate newly painted surfaces.

Every precaution shall be taken to prevent damage to adjacent buildings, shrubs and motor vehicles. Shrubs shall be cut back from structures to be painted. Roping, barricading or covering to preclude damage to personal and real property during surface preparation and painting shall be the Contractor's responsibility. When spray painting, the Contractor must give 24 hours advance warning, coordinated with the Contracting Officer or his representative, and post signs to ensure parking arrangements can be made. Repairs to damaged surfaces shall be effected at no additional cost to the Government.

3.3 SURFACE PREPARATION

3.3.1 General Surface Preparation

All surfaces shall be clean, dry, and free from contaminants and foreign matter. Mildew and chalking shall be removed and the surface thoroughly sterilized. All chipped, peeling, or blistered paint shall be removed and the surface spot-primed. Hard, glossy surfaces shall be dulled and roughened to ensure proper adhesion.

3.3.2 Earth and Masonry or Concrete Interface

Where applicable, soil shall be hand removed to expose 4 inches of cement block wall below grade level. Exposed cement block shall receive the same treatment under this specification as the cement block above grade level. Soil shall be replaced to restore the original grade no sooner than 48 hours after the block painting is complete.

3.3.3 Metal Surfaces

All heavy rust and loose mill scale shall be removed from steel in accordance with SSPC SP 3, Power Tool Cleaning.

Minor aluminum oxide film and corrosion shall be removed by hand or power tool cleaning.

Previously unpainted galvanized and aluminum surfaces shall be treated with wash primer in accordance with manufacturer's instructions.

3.4 MIXING AND APPLICATION

3.4.1 General

All painting shall be accomplished in accordance with the painting schedule.

No exterior painting shall be allowed in rainy weather or when rain is imminent. No paints or coatings shall be applied when the temperature or humidity is outside the limits recommended by the manufacturer.

Paints and coatings shall be applied by brush, roller, or airless spray.

Each coat of material applied shall be free from runs, sags, bubbles, and foreign contaminants; variations in color, gloss and texture; dry overspray, brush, and roller marks; holidays (missed areas); or other evidence of poor application.

All paints and coatings shall be thoroughly worked into corners and crevices.

Paints and coatings shall be neatly "cut-in" around doors, windows, ceilings, etc.

All newly painted surfaces shall be adequately protected from damage.

3.4.2 Procedures

Coatings shall be applied as follows:

a. Material shall be thoroughly stirred to produce a uniform mixture.

b. Material shall be thinned for workability and improved spray characteristics, but only according to the manufacturer's instructions.

c. Each coat shall be applied uniformly at the minimum wet-film thickness specified by the manufacturer.

d. Special attention shall be given when coating sharp edges, corners, and crevices to ensure complete coverage.

e. Finish coats shall show good hiding characteristics and uniform appearance.

3.4.3 Exterior Surfaces

Metal surfaces shall be primed with alkyd primer in accordance with manufacturer's instructions, and topcoated with two coats enamel in accordance with manufacturer's instructions.

Paint shall be allowed to dry overnight before re-coating.

3.5 SPOT-PAINTING

Spot-painting to correct damaged surfaces will be allowed only when touchup area blends into the surrounding finish. Otherwise, the entire area shall be recoated. Touchup shall be accomplished using the same method of application as was used to apply the original material.

3.6 ACCEPTANCE PROVISIONS

3.6.1 Inspection

Contractor shall provide for inspection of his work to ensure that the requirements of this section have been fulfilled.

3.6.2 Cleanup

Contractor shall be responsible for removal of all paint or coating splatter and spills from floors, adjacent walls, hardware, and all other finished surfaces.

Contractor shall leave the work area clean and free from all rubbish and accumulated material left from his work.

3.7 PAINT SCHEDULE

3.7.1 Exterior Paint Schedule

Colors shall be in accordance with FED-STD-595.

SURFACE	PRIMER	FINISH COAT	FINISH COLOR AND SHEEN
Exterior Metal Piping	Zinc-rich Urethane	Aliphatic Urethane	Green

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2.1.2.3 Protective (Corrosion Resistant) Epoxy Lining
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SECTION 09 93 00

CONCRETE REPAIR AND HYDROGEN SULFIDE PROTECTIVE COATING

PART 1 GENERAL

1.1 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment, and incidentals required to install and test, complete and ready for operation, the repair and protective coating/lining of existing concrete structure (s) as specified herein and as shown on the drawings.

The Contractor shall provide all labor, materials, equipment, and incidentals required:

a. To meet all of the OSHA requirements for performing work in a confined space.

b. To provide positive ventilation in the confined space.

c. To provide all bypass pumping to perform the required work.

d. To provide all wastewater flow control(s) and diversion(s) to properly isolate the work area(s).

Concrete repair or concrete preparation work of 1/2-inch in depth or less shall be the subsidiary/ancillary obligation of the Contract and no additional payment shall be made for this work.

1.2 RELATED WORK

The contract documents include, but are not limited to, the related requirements for concrete work specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

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.

ACI INTERNATIONAL (ACI)

ACI 308	(2001) Guide to Curing Concrete

ASTM INTERNATIONAL (ASTM)

ASTM D 4787	(2008) Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI 03732	(1997) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings,

	and Polymer Overlays
ICRI CSP 5	(1997) Concrete Surface Profile 65-70 mils
ICRI CSP 6	(1997) Concrete Surface Profile 70-75 mils
ICRI CSP 8	(1997) Concrete Surface Profile 80-85 mils

NACE INTERNATIONAL (NACE)

NACE 1	White Metal Blast Cleaning
NACE 2	Near-White Blast Cleaning

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 1	(1982; R 2004) Solvent Cleaning
SSPC SP 10	(2000; R 2004) Near-White Blast Cleaning
SSPC SP 5	(2000; R 2004) White Metal Blast Cleaning
SSPC VIS 1	(2002) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G

SD-03 Product Data

Product Literature; G

1.5 DELIVERY, STORAGE, AND HANDLING

All materials shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed.

All materials, equipment, and parts must be properly protected against any damage during a prolonged period at the site.

Each box or package shall be properly marked to show its net weight in addition to its contents.

1.6 SHOP DRAWINGS

Submit certified shop drawings showing all details of concrete repair and protective coating installation.

1.7 PRODUCT LITERATURE

Submit descriptive literature, bulletins, and catalogs of the protective coating and concrete repair materials and cleaning procedures.

1.8 QUALIFICATIONS

All of the protective coating material specified herein shall be furnished by a single manufacturer who regularly engages in the production of this type of hydrogen sulfide protective coating material who is fully experienced, reputable, and qualified in the manufacture of the coating to be furnished. If resurfacing greater than 1/2-inch in depth is required, a different manufacturer may be used for these deep concrete repairs. Material furnished under this Specification shall be new and unused, of the type, components, and efficiency installed on previous projects and the product of a manufacturer having a successful record of operation, manufacturing and service for a minimum of 5 years prior to bid date. Manufacturer shall supply Contracting Officer with previous installation details including references with current phone numbers for a minimum of 10 previous projects which used the specified protective coating/lining system(s).

The protective coating manufacturer shall instruct the protective coating manufacturer applicator or the Contractor in the proper procedures in applying the protective coatings. The Contractor shall guarantee that the prepared surfaces to be coated and the application of the protective coating are suitable for the purpose intended and free from defects of material and workmanship.

The protective coating shall be Tnemec Series 218 MortarClad/Tnemec Series 434 Perma-Shield/Tnemec Series 435 Tnemec-Glaze by Tnemec Company, Sauereisen series F-120 or 121/210T or RS/210G by Sauereisen Inc., or equal as specified.

1.9 WEATHER CONSTRAINTS

Maintain substrate temperature and air temperature before, during, and after installation in accordance with Protective Coating Manufacturer's written recommendations and instructions. Contractor shall protect areas to be coated from the elements of direct weather (sunlight, rain, wind, etc.) and inclement weather during the application and curing period of the coatings.

Provide adequate ventilation during application and curing periods.

1.10 WARRANTIES

Warranties shall be in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS. Additionally, the protective coating manufacturer shall warranty its products as free from material defects for a minimum period of one year.

Contractor shall warranty the installed protective coating/lining system as free from material and workmanship.

1.11 PATENTS AND LICENSES

The Contractor shall be responsible for all patents or licenses that exist on the materials that may be provided.

The Contractor and Manufacturer shall assume all costs of patent fees or licenses for the materials or process; and shall safeguard and save harmless the Government from all damages, judgments, claims and expenses arising from license fees, or claimed infringement of any letters, patent or patent rights, or fees for the use of any equipment or process structural feature or arrangement of any of the component parts of the installation; and the price bid shall be deemed to include payment of all such patent fees, licenses or other costs pertaining thereto.

PART 2 PRODUCTS

2.1 MATERIALS

The protective lining system shall be a multi-component protective lining system, including:

a. Concrete restoration, where required with epoxy or cementitious resurfacing/underlayment materials as specified herein and in accordance with Protective Coating/Lining Manufacturer's recommendations.

b. A basecoat of trowelable or sprayable aggregate filled epoxy lining at 125 mils dry film thickness (dft) for corrosion and abrasion resistance against the physical and chemical attack phenomena typically associated with municipal wastewater service conditions.

c. Epoxy sealer coat at 15 to 20 mils dft to provide a smooth and sealed finished surface profile.

d. Contractor shall provide all accessory components of the system such as infiltration control products or other compounds as recommended by the protective coating manufacturer for maximum protective lining adherence to substrate and long-term service performance.

e. All cementitious materials should be cured and prepared per ACI 308.

2.1.1 Products - Sauereisen

2.1.1.1 Cementitious Resurfacer/Underlayment

Sauereisen F-120 Underlayment or F-121 Substrate Resurfacer. Minimum thickness - 1/8 inch.

Where existing concrete has been damaged to depth of 1/2-inch to 2 inches, the cementitious resurfacer/underlayment shall be applied in accordance with the manufacturer's instructions and requirements.

2.1.1.2 Protective (Corrosion Resistant) Epoxy Lining

Sauereisen SewerGard No. 210T or 210RS. Minimum applied thickness (dry film) - 120 mils.

Epoxy lining shall be an aggregate-filled, trowel or spray applied epoxy polymer protective lining material specifically designed to protect concrete and steel surfaces of wastewater structures subjected to municipal wastewater service conditions, including associated abrasive physical attack and chemical attack mechanisms related to hydrogen sulfide and organic acids generated by microbial sources.

2.1.1.3 Epoxy Protective Lining Sealer Coat

Sealer Coat - Sauereisen SewerGard No. 210 Glaze. Minimum applied thickness (dry film) - 15 mils.

The unfilled epoxy sealer coat at 15 to 20 dft mils is required to enhance corrosion and abrasion resistance and reduce permeability.

2.1.2 Products - Tnemec

2.1.2.1 Cementitious Resurfacer

For concrete surfacing from a depth of 1/2-inch to 2 inches use the following:

a. Sika 123 Substrate Resurfacer or other as approved by Tnemec. Minimum thickness - 1/2 inch.

b. Where existing concrete has been damaged to a depth of 1/2-inch to 2 inches, the cementitious resurfacer/underlayment shall be applied and cured in accordance with the manufacturer's instructions and requirements. Note: This product can be applied to bare, abrasive-blasted rebar. Following proper curing of the resurfacer, abrasive blast to an ICRI CSP 5.

c. Apply one coat of Tnemec Series 1 Omnithane at 3.0 - 4.0 mils dft.

2.1.2.2 Cementitious Mortar Surfacer

For concrete surfacing for a depth of up to 1/2-inch use the following:

a. Tnemec Series 218 MortarClad Mortar. Minimum thickness - 1/8 to 1/4-inch; maximum of 1/2-inch.

b. To be used directly to the existing concrete if surfacing of less than 1/2-inch is required. May also be required if the surface preparation of the Sika 123 or resurfacer used exceeds an ICRI CSP 8.

2.1.2.3 Protective (Corrosion Resistant) Epoxy Lining

a. Tnemec Series 434 Perma-Shield. Minimum applied thickness (dry film) - 125 mils.

b. Epoxy lining shall be an aggregate-filled, trowel or spray applied epoxy polymer protective lining material specifically designed to protect concrete and steel surfaces of wastewater structures subjected to municipal wastewater service conditions, including associated abrasive physical attack and chemical attack mechanisms related to hydrogen sulfide and organic acids generated by microbial sources.

2.1.2.4 Epoxy Protective Lining Sealer Coat

a. Tnemec Series 435 Perma-Glaze. Minimum applied thickness (dry film) - 15 mils.

b. The unfilled epoxy sealer coat at 15 to 20 dft mils required to enhance corrosion and abrasion resistance and reduce permeability.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of the protective coating shall be in strict accordance with the manufacturer's instructions and recommendations. Preparation of the existing concrete surfaces for the application of the protective coatings shall also meet the protective coating/lining manufacturer's requirements.

3.2 INSPECTION

The Contractor shall high-pressure clean and wash as necessary the areas to be coated as required for observation by the Government to determine the concrete area that is going to require concrete repair of a depth of 1/2-inch to 2 inches in depth. This observation shall also determine areas of concrete repair and/or rebar repair that will exceed 2 inches in depth. Contractor will schedule the inspection of the cleaned areas at least 7 days in advance. Contractor shall provide all equipment necessary for the Government to safely enter into the lift stations or manholes during this inspection(s). Contractor will provide proper ventilation, sufficient lighting, protective gear, safety equipment, etc. as required to enter the interior of the wet well. The Contractor shall have to bypass pump or otherwise handle the lift station or manhole wastewater flow to allow the plant to remain in operation during the inspection or inspections. The Contractor shall properly accommodate/repair these nonsealing valves to stop the wastewater flow when performing this work. Upon the determination of these areas to be repaired, they will be located (on the as-built drawings) and measured by the Contractor in the presence of the Government. The agreed to quantities shall be the basis for the Contractor's unit cost payment. These areas shall be repaired as required. Should the damaged area become more extensive than originally determined (i.e., to a depth of more than 2 inches), the Contractor and Government shall agree to the cost for this additional work prior to proceeding. No repair work shall be paid for unless the Government agrees to it prior to repair being initiated.

The Contractor shall not proceed with the final two protective coatings until concrete preparation has been completed and unsatisfactory concrete surface conditions have been corrected in a manner acceptable to Government/ Contracting Officer.

3.2 SURFACE PREPARATION

3.2.1 Existing Concrete Surfaces

Existing concrete structures to receive protective lining system must be capable of withstanding imposed loads. All oil, grease and chemical contaminants must be removed from the surface of the concrete. All surfaces must be firm, free of damaged or contaminated concrete, laitance, form release agents, and standing water and they must be structurally sound as determined by Contracting Officer. Suitable surface preparation methods include shot blasting, abrasive blasting, or hydroblasting. Surface preparation procedures shall be in accordance with ICRI 03732. Surface preparation requirement is to exposed aggregate and obtain a uniform surface texture resembling an ICRI CSP 5 and ICRI CSP 6 comparators.

All voids in the concrete and bugholes shall be opened to the degree that coating can completely fill these voids and no off-gassing occurs after the coatings are applied and allowed to dry.

3.2.2 Metal Surfaces

Metal Application - Remove all visible oils, grease in accordance with SSPC SP 1, section 2.1. Remove contaminants from surface in accordance with SSPC SP 1 section 3.2. Using CHLOR*RID INTERNATIONAL "CHLOR*TEST" test kits, or approved equivalent method, determine level of chlorides on the metal surfaces. Level of acceptable chlorides shall be no more than 3 micro-g/cm^2 for immersion and no more than 5 micro-g/cm^2 for atmospheric conditions. Surfaces with unacceptable levels must be washed with CHLOR*RID, or approved equal, in accordance with protective coating manufacturer's recommendations and then retested.

Using SSPC VIS 1 as a guide, abrasive blast to a NACE 1/SSPC SP 5 white metal blast for immersion and a NACE 2/SSPC SP 10 for other service conditions. An anchor profile range of 2.5 - 3.0 mil is preferable. All welds must be continuous, free of flux and have a smooth rounded radius without any sharp edges or be ground flat and free of flux, fins and spatter.

Consult protective coating manufacturer for primer recommendations or metal.

3.2.3 Removal of Surface Preparation Materials

All surface preparation materials including, but not limited to, sand, shot, abrasive materials, degreasers, etc. as well as removed materials (concrete particulates, metal filings, damaged materials, rusted metal, etc.) shall be removed from the work site and properly disposed of offsite by the Contractor. Contractor shall not allow any of the surface preparation materials or removed materials to enter the treatment plant process.

3.3 APPLICATION

Protective coating systems shall be installed when ambient air and surface temperatures are between 60 degrees and 85 degrees F. Store coating materials within the 60 degree and 85 degree F range for 48 hours before use. Application and storage temperatures outside this range will require written instruction and approval from the protective coating manufacturer. Ensure that moisture content is in accordance with manufacturer's requirements.

Application in direct sunlight and/or with rising surface temperatures is not recommended, as this may result in blistering outgassing of the materials due to expansion of entrapped air or moisture (outgassing) in the concrete. In such cases, it will be necessary to postpone the application until later in the day when the temperature of the substrate is falling. Concrete surfaces that have been in direct sunlight must be shaded for at least 24 hours before application and remain shaded until the initial set has taken place. Consult protective coating manufacturer for application schedule guidelines specific to temperature conditions and possible sealer application recommendations to reduce/eliminate outgassing.

All substrate repairs required by the Contracting Officer or as specified in the Bid/Contract Documents must be in accordance with the recommendations and requirements of the protective coating manufacturer. Written approval by the protective coating manufacturer is required for all substrate repairs prior to applying the coatings. Concrete substrate repair shall consist of removing all damaged or defective concrete to a

depth of 1/8-inch into sound concrete in all directions from the damaged areas. No rebar, expansion joints, embedments, other items shall be damaged during this process. The Contracting Officer shall agree that the Contractor has reached sound concrete. Any damaged items shall be properly repaired at no cost to the Government.

Should the repair include an area around any existing exposed rebar, all rust on the rebar shall be sandblasted off. If the rebar has been damaged, the Contracting Officer shall be contacted to determine if rebar replacement is required.

Protective epoxy lining and the epoxy protective lining sealer coat shall be applied and cured on the properly prepared surfaces in accordance with protective coating system manufacturer's written guidelines and as specified herein.

Expansion and construction joints shall be formed and filled as recommended by the protective coating manufacturer.

3.4 HIGH VOLTAGE SPARK TESTING

Installed protective epoxy lining shall be tested by the Contractor in the presence of the Government/Contracting Officer for pinholes after a minimum 24-hour cure at a temperature of 70 degrees F. Pinhole testing shall be accomplished in accordance with ASTM D 4787, using a Tinker Razor Holiday Detector, San Gabriel, CA, Model AP/W, or an approved equal device. Test voltage of 100 volts/mil of coating thickness shall be applied. All pinholes shall be marked and repaired using manufacturer's approved Patch Kit or other approved method in accordance with written recommendations from the protective coating manufacturer.

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BASIC ELECTRICAL MATERIALS AND METHODS

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 in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z535.4	(1998) Product Safety Signs and Labels

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; Errata 2007; INT 2008) National Electrical Safety Code
IEEE C57.12.28	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE Std 100	(2000) The Authoritative Dictionary of IEEE Standards Terms

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2008; AMD 1 2008) National Electrical Code - 2008 Edition

1.2 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 Std 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.

1.3 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.3.1 Shop Drawings (SD-02)

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.

1.3.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.4 QUALITY ASSURANCE

1.4.1 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 Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.2 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.

1.4.2.1 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.

1.4.2.2 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.

1.5 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.

1.6 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.

1.7 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.

1.8 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 400 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 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. Provide arc flash warning signs for all electrical equipment in accordance with the provisions of NFPA 70. Appearance and format of arc flash warning signs shall conform to ANSI Z535.4.

1.9 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.10 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.

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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 the section specifying the associated electrical equipment.

3.2 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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COMMON WORK RESULTS FOR ELECTRICAL

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 D 709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.12.28	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2005) Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE Std 100	(2000) The Authoritative Dictionary of IEEE Standards Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FB 1	(2007) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA KS 1	(2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA OS 2	(2003) Standard for Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA RN 1	(2005) Standard for Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2003) Standard for Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
NEMA TC 3	(2004) Standard for Polyvinyl Chloride PVC Fittings for Use With Rigid PVC Conduit and Tubing
NEMA WD 6	(2002; R 2008) Standard for Wiring Devices - Dimensional Requirements

NEMA Z535.1 (2006) Standard for Safety Colors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2008; AMD 1 2008) National Electrical Code - 2008 Edition

UNDERWRITERS LABORATORIES (UL)

UL 489 (2009) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

UL 6 (2007) Standard for Electrical Rigid Metal Conduit-Steel

UL 797 (2007) Standard for Electrical Metallic Tubing -- Steel

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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

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
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.

1.3 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). 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.

1.4 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 Std 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.

1.5 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.

1.6 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.

1.7 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.

1.8 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.

1.9 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including 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 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.

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.

All hardware and accessories including, but not limited to, couplings, hubs, conduit bodies, straps, hangars and boxes, and elbows shall be PVC coated in accordance with NEMA RN 1.

All conduit and fittings shall have an exterior PVC coating with a minimum thickness of 40 mils and an interior PVC coating with a minimum thickness of 2 mils. All hardware and accessories shall have an exterior PVC coating with a minimum thickness of 20 mils.

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 Rigid Nonmetallic Conduit

Rigid nonmetallic conduit shall comply with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 40.

2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 600-volt type THWN. All conductors AWG No. 8 and larger, shall be stranded. All conductors smaller than AWG No. 8 shall be stranded.

Flexible cable shall be Type SO and contain a grounding conductor with green insulation.

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 bolted clamp-type connectors. 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 NEMA Z535.1.

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 NEMA FB 1 and NEMA OS 2 and be not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

2.7 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 and 22,000 amperes rms symmetrical at 480 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.

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

Follow Manufacturer's recommended installation practices for installing PVC coated rigid galvanized steel conduit. Use tools specifically designed for PVC coated conduit during the installation process including, but not limited to, clamping, cutting, threading, bending, and assembly of conduit.

Touch up damaged coating with according to Manufacturer's instructions using Manufacturer's approved touchup compound.

Where the conduit is field threaded, apply electrically conductive, corrosion resistant compound to the threads in accordance with NFPA 70 NEC 300.6 A.

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 or slabs for connections to free-standing equipment with a flush coupling. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.

All outdoor conduits shall be PVC coated rigid galvanized steel unless otherwise noted.

3.1.2 Electrical Metallic Tubing (EMT)

EMT shall be grounded in accordance with NFPA 70, using pressure grounding connectors especially designed for EMT.

3.1.3 Rigid Nonmetallic Conduit

Rigid PVC conduit may be used for underground conduits where conduits do not extend into lift station wetwells.

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 NFPA 70.

3.1.4 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
Phase A	Brown
Phase B	Orange
Phase C	Yellow
Neutral	White
Equipment Grounds	Green

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 NFPA 70. 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 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 having1/4 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.

3.6 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.

3.7 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted as specified in Section 09 90 00.00 98 PAINTING AND COATING.

3.8 FIELD TESTING

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.

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LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES

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 D 877	(2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.90	(2005) Standard for Relays and Relay Systems Associated With Electric Power Apparatus
IEEE C57.13	(2008) Standard Requirements for Instrument Transformers

IPC - ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)

IPC D330	(1992) Switches

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
NEMA AB 3	(2001) Molded Case Circuit Breakers and Their Application
NEMA C12.1	(2008) Electric Meters; Code for Electricity Metering
NEMA C78.23	(1995; R 2003) Standard for Incandescent Lamps - Miscellaneous Types
NEMA FU 1	(2002; R 2007) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000; R 2005; R 2008) Standard for Industrial Control and Systems General Requirements
NEMA ICS 2	(2000; Errata 2002; R 2005; Errata 2006)

	Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
NEMA ICS 6	(1993; R 2006) Standard for Industrial Controls and Systems Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2008; AMD 1 2008) National Electrical Code - 2008 Edition

UNDERWRITERS LABORATORIES (UL)

UL 489	(2009) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 508	(1999; Rev thru Sep 2008) Standard for Industrial Control Equipment

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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

Enclosures
Circuit Breakers
Control Devices
Protective Relays
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:

Magnetic Motor Controllers
Combination Motor Controllers
Circuit Breakers
Protective Relays

1.3 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 Magnetic Motor Controllers

2.1.1.1 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.

Provide solid state overload (SSOL) relays with the following features:

a. Phase loss protection; trips within 3 seconds
b. Phase unbalance protection
c. Ground fault trip when selected
d. Selectable trip class 5, 10, 20 or 30
e. Reset trip with selected Auto/Manual
f. Dip Switch selectable with the following features:
Set Phase Unbalanced ON or OFF
Set Phase Loss ON or OFF
Set Reset to Manual or Automatic
Set Ground Fault ON or OFF
g. Overload shall be self powered with no need for external power source

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 4X.

2.1.2 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.

2.1.2.1 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 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.

2.2 ENCLOSURES

2.2.1 Equipment Enclosures

Provide enclosures for equipment in accordance with NEMA 250.

Contain equipment installed in wet locations in a NEMA Type 4X watertight, corrosion-resistant sheet-steel enclosure, constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 for Type 4X enclosures.

Contain equipment installed in Class I, Division I, Group A, B, C, and D, hazardous locations, in NEMA Type 7 enclosures approved for the specific flammable gas or vapor that is possibly present under normal operating conditions.

2.3 CIRCUIT BREAKERS

Provide circuit breakers that conform to UL 489, NEMA AB 1, and NEMA AB 3.

2.3.1 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 NFPA 70 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.

2.3.2 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 NEMA AB 1.

Provide enclosed circuit breakers in nonhazardous locations as follows:

Contain circuit breakers installed in wet locations, in NEMA Type 4, watertight corrosion-resistant sheet steel enclosures constructed to prevent entrance of water.

2.4 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.

2.5 CONTROL DEVICES

2.5.1 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.

2.5.2 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 and 24-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.

2.5.3 Pushbuttons and Switches

2.5.3.1 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.

2.5.3.2 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.

2.5.3.3 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.

2.6 PROTECTIVE RELAYS

2.6.1 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.

2.7 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.

2.8 INDICATING LIGHTS

2.8.1 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 NEMA 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.

2.9 FINISH

Protect metallic materials against corrosion. Provide equipment 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, refer to Section 09 90 00.00 98 PAINTING AND COATING.

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 NFPA 70, 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 NEMA 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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VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS

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.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1	(2002; R 2008) IEEE Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE Std 519	(1992; Errata 2004) Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2005; R 2008) Standard for Industrial Control and Systems General Requirements
NEMA ICS 3.1	(1997; R 2003) Industrial Control and Systems: Handling, Storage and Installation Guide for AC General-Purpose Medium Voltage Contactors and Class E Controllers, 50 and 60 Hertz
NEMA ICS 6	(1993; R 2006) Standard for Industrial Controls and Systems Enclosures
NEMA ICS 7	(2006) Industrial Control and Systems: Adjustable-Speed Drives

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2008; AMD 1 2008) National Electrical Code - 2008 Edition

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-461	(Rev F) 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	(2009) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 508C	(2002; Rev thru Feb 2008) Power Conversion Equipment

1.2 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 SYSTEM DESCRIPTION

1.3.1 Performance Requirements

1.3.1.1 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.

1.3.1.2 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.

1.3.2 Electrical Requirements

1.3.2.1 Power Line Surge Protection

IEEE C62.41.1 and IEEE C62.41.2, IEEE Std 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.

1.3.2.2 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.

1.4 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-02 Shop Drawings

Schematic diagrams; G

Interconnecting diagrams; G

Installation drawings; G

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; G

Wires and cables

Equipment schedule

Include data indicating compatibility with motors being driven.

SD-06 Test Reports

VFD Test

Performance Verification Tests (2)--One before testing and one with the test results filled in for permanent record.

Endurance Test

SD-08 Manufacturer's Instructions

Installation instructions

SD-09 Manufacturer's Field Reports

VFD Factory Test Plan; G

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 MAINT ENANCE 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.

1.5 QUALITY ASSURANCE

1.5.1 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.

1.5.2 Interconnecting Diagrams

Show interconnections between equipment assemblies, and external interfaces, including power and signal conductors. Include for enclosures and external devices.

1.5.3 Installation Drawings

Show floor plan of each site, with V.F.D.'s and motors indicated. Indicate ventilation requirements, adequate clearances, and cable routes.

1.5.4 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.

1.5.5 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.

1.5.6 Factory Test Results

Document test results and submit to government within 7 working days after completion of test.

1.6 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.

1.7 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.

1.8 MAINTENANCE

1.8.1 Spare Parts

Manufacturers provide spare parts in accordance with recommended spare parts list.

1.8.2 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 maintenancee 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 22,000 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, + or - 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 + / - 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, NFPA 70.

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 contracting officer 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 contracting officer.

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

Provide two 2-hour training sessions with one training session during the second workshift.

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

-- End of Section --

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DIVISION 31 - EARTHWORK

SECTION 31 00 00

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SECTION 31 00 00

EARTHWORK

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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 145	(1991; R 2000) Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
AASHTO T 180	(2001; R 2004) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop
AASHTO T 2	(1991; R 2006) Standard Method of Test for Sampling of Aggregates (same as ASTM D 75)
AASHTO T 87	(1986; R 2004) Standard Method of Test for Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA P5	(2005) Standard for Waterborne Preservatives

ASTM INTERNATIONAL (ASTM)

ASTM A 139/A 139M	(2004) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A 252	(1998; R 2007) Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM D 1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 2216	(2005) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2487	(2006e1) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 3740	(2004) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D 422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6938	(2007a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Satisfactory materials shall mean ASTM D 2487, SP, SP-SM, SM, A-2-3, A-2-4, and A-3.

1.2.2 Unsatisfactory Materials

Unsatisfactory soil materials shall mean ASTM D 2487, GW, GP, GM, GP-GM, CW-GM, GC, GP-GC, GM-GC, SW, SW-SM, SC, SW-SC, SP-SC, CL, ML, CL-ML, CH, MH, and AASHTO M 145, Soil Classification Groups A-2-5, A-2-6, A-2-7, A-4, A-5, A-6, and A-7, peat, muck and other highly organic soil, and other highly organic material, buried vegetation, roots, and post consumer materials such as trash, refuse, or other debris and soil materials of any classification that have a moisture content at the time of compaction beyond the range of 1 percentage point below and 3 percentage points above the optimum moisture content of the soil material as determined by moisture-density relations test.

1.2.3 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure, Method B or D.

1.2.4 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.3 DEWATERING WORK PLAN

Submit procedures for accomplishing dewatering work in accordance with drawings.

1.4 QUALITY CONTROL TESTING DURING CONSTRUCTION

Soil survey for satisfactory soil materials and samples of soil materials shall be furnished by the Contractor. A certified soil-testing service approved by the Contracting Officer shall be provided by the Contractor. Testing shall include soil survey for satisfactory soil materials; sampling and testing soil materials proposed for use in the work, and field-testing facilities for quality control during construction period.

Testing agencies shall conform to the requirements of ASTM D 3740.

Soil materials shall be tested by the Contractor during construction as follows:

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Satisfactory soil materials	Sieve analysis of fine and coarse aggregates	ASTM C 136	One daily for each soil material from each source; additional test whenever there is any apparent change
	Preparation of samples	AASHTO T 87	
	Sieve analysis is of fine and coarse aggregates	ASTM C 136	
	Amount of material passing No. 200 sieve	ASTM C 117	
	Moisture content of subbase material	ASTM D 2216	
Soil materials prior to compaction	Moisture-density relations of soil	ASTM D 1557	One of each type of subgrade soil material except under backfill for structures;

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
			one for each backfill and fill material from each source
Soil material-in-place after compaction	Density of soil-in-place	ASTM D 1556 Sand Cone Method	At least three daily for each subgrade soil material except under backfill for structures, and for each layer and backfill and fill material; for each 400 linear feet of trench or fraction thereof, whichever is greater; and additional test whenever there is any change in moisture conditions

1.5 TEST REPORTS

No soil material shall be used until a written report of Soil Test results has been reviewed and approved by the Contracting Officer.

1.6 EXISTING CONDITIONS

Records of Underground Utilities Location of Inspections, Location of Testing and Location of Utility Approvals shall be submitted to the Contracting Officer prior to start of work.

1.7 DRAWINGS

As-Built Drawings shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

1.8 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring; G

Dewatering Work Plan; G

Submit 15 days prior to starting work.

Contractor shall record Existing Conditions prior to starting work in accordance with the paragraph entitled, "Existing Conditions," of this section.

SD-02 Shop Drawings

As-Built Drawings shall be submitted in accordance with paragraph entitled, "Drawings," of this section.

SD-06 Test Reports

Borrow Site Testing

Within 24 hours of conclusion of physical tests, 6 copies of test results, including calibration curves and results of calibration tests. Results of testing at the borrow site.

Contractor shall submit written Test Reports of Soil Test results within 5 calendar days. Submit test reports in accordance with paragraph entitled, "Quality Control Testing During Construction," of this section.

SD-07 Certificates

Certificates for Proposed Soil Materials shall be submitted to the Contracting Officer in accordance with paragraph entitled, " Backfill and Fill Materials," of this section.

Certificates of Compliance for Compost shall be submitted indicating grade and compliance to state and local regulations.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill shall contain a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCLP test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 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. Do not bring material onsite until tests have been approved by the Contracting Officer.

2.2 BACKFILL AND FILL MATERIALS

Backfill and fill material shall consist of sandy clay, sand, gravel, soft shale, or other satisfactory soil materials as defined in Subpart 1.2.1 Satisfactory Materials.

Materials for backfill and fill shall be satisfactory soil materials, free of clay clods, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials and other deleterious matter, and shall be

satisfactory soil material as follows:

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Satisfactory soil materials	Sampling	AASHTO T 2	One for each source of material to determine conformance to definition of satisfactory soil materials; additional tests whenever there is any apparent change
	Preparation of samples	AASHTO T 87	
	Sieve analysis of fine and coarse aggregate	ASTM C 136	
	Mechanical analysis of soils	ASTM D 422	
	Liquid limit of soils	ASTM D 4318	
	Plastic limit and plasticity index of soils	ASTM D 4318	
	Moisture-density relations of soil	AASHTO T 180, Method B or D	

2.3 COHESIONLESS MATERIALS

Cohesionless soil materials include gravels, gravel-sand mixtures, sands, and gravelly-sands. Moisture-density relations of compacted cohesionless soils, when plotted on graphs, will show straight lines or reverse-shaped moisture density curves.

2.4 COHESIVE MATERIALS

Cohesive soil materials include clayey and silty gravels, sand-clay mixtures, gravel-silt mixtures, clayey and silty sands, sand-silt mixtures, clays, silts, and very fine sands. Moisture-density relations of compacted cohesive soils, when plotted on graphs, will show normal moisture-density curves.

2.5 SUBBASE MATERIAL

Subbase material shall be a naturally or artificially graded mixture of natural or crushed gravel, crushed stone, or sand.

2.6 COMPOST

Compost shall be yard trimmings or yard waste compost processed and graded according to state and local regulations.

2.7 COMPACTION EQUIPMENT

Compaction equipment shall consist of sheepsfoot rollers, pneumatic-tired rollers, tamper rollers, vibrating tampers, or other compaction equipment capable of obtaining the required density throughout the entire layer.

2.8 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 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. 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

2.8.1 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.

2.8.2 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.

2.9 DETECTION WIRE FOR NON-METALLIC PIPING

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.10 GROUT

Provide durable grout composed of cement, water, an air-entraining admixture, and sand mixed in proportions of one part portland cement to two parts of sand, sufficient water to produce a workable mixture, and an amount of admixture which will entrain sufficient air, as determined by the Contracting Officer. Mix grout in a concrete mixer.

2.11 PIPE CASING

2.11.1 Casing Pipe

ASTM A 139/A 139M, Grade B, or ASTM A 252, Grade 2, smooth wall pipe. Match casing size to the outside diameter and wall thickness as indicated

on the drawings. Protective coating is to be epoxy-fusion bonded.

2.11.2 Wood Supports

Pressure-treated, 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 GENERAL REQUIREMENTS

Before starting earthwork, the location of underground utilities shall be carefully verified by hand methods. Utilities to be left in place shall be protected from damage.

Excavation, filling, backfilling, and grading shall be to subgrade elevations specified.

Excavated materials suitable for backfill shall be piled in an orderly manner sufficiently distant from excavations to prevent overloading, slides, and cave-ins.

Excavations shall be done in ways that will prevent surface water and subsurface water from flowing into excavations and will also prevent flooding of the site and surrounding area.

3.2 UNAUTHORIZED EXCAVATION

Unauthorized excavation shall consist of removal of materials beyond indicated subgrade elevations or side dimensions specified without specific direction and shall be replaced as specified at no additional cost to the Government.

Unauthorized excavation under foundations or retaining walls shall be filled by lowering the bottom elevation of the footing or base to the excavation bottom without altering the approved top elevation.

Elsewhere unauthorized excavations shall be backfilled and compacted as specified for authorized excavations of the same classification.

3.3 SURFACE PREPARATION

Heavy growths of grass and other vegetation, roots, debris, stones, objects larger than 2 inches in any dimension, and other materials undesirable to the subsurface construction shall be removed by mowing, grubbing, raking, or other methods from the surface of areas to be stripped.

3.3.1 Stripping Of Topsoil

Where indicated or directed, strip topsoil to a depth of 4 inch. 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 inch in diameter, and other materials that would interfere with planting and maintenance operations. Excavated topsoil shall be transported to, and stockpiled in,

designated topsoil storage areas.

3.3.2 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. 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.

3.3.3 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.

3.3.4 Pruning

Trim trees designated to be left standing within the cleared areas of dead branches 1 1/2 inches or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1 1/4 inches in diameter with an approved tree wound paint.

3.3.5 Grubbing Operations

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 as areas to be paved and sodded. 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 10 feet below the original surface level of the ground in areas indicated as areas for buildings, dry retention ponds and in a 10 foot wide perimeter around Buildings.

3.3.6 Filling Depressions

Depressions resulting from grubbing operations shall be completely filled with acceptable backfilling material, unless further excavation or earthwork is required.

Prior to filling, subgrade surfaces of depressions shall be free of standing water, frost, or frozen material. Unsatisfactory soil materials shall be removed.

Any structural backfill or fill required for site development should be placed in loose lifts not exceeding 12 inches in thickness and compacted by the use of a vibratory drum roller. If hand-held or track-mounted compaction equipment is used, the lift thickness should be reduced to 6 and 8 inches, respectively. Each layer shall be compacted at the optimum moisture content to a density equal to the original adjacent ground. Surface of filled depressions shall be graded to meet adjacent contours and to provide surface water drainage.

3.3.7 Stability of Sides

Sides of excavations over 5 feet in depth shall be sloped not steeper than 34 degrees from the horizontal (slope 1/1.5) of the material excavated or shall be shored and braced where sloping is not possible because of space restrictions, stability of material excavated, or where excavations are subjected to vibrations from vehicular traffic, the operation of machinery, or any other source.

Sides and slopes of excavations shall be maintained in a safe condition by scaling, benching, shelving, or bracing until completion of backfill placement.

3.3.8 Shoring and Bracing

Shoring and bracing in excavations shall be maintained for the entire length of time excavations will be open. Shoring and bracing shall be carried down with the excavation.

Sheeting used to prevent lateral movement of soil shall be removed in accordance with the requirements.

Untreated sheeting shall not be left in place beneath structures or pavements.

3.4 GENERAL EXCAVATION

3.4.1 Ditches, Gutters, and Channels

Excavation shall be accomplished by cutting accurately to the cross sections, grades, and elevations indicated. Excessive open-ditch or gutter excavation shall be backfilled with suitable materials to grade at no additional cost.

3.4.2 Utility Structures

Excavation for manholes, wet wells, valve vaults, and similar structures shall be sufficient to leave at least 12 inches in the clear between the outer surfaces and the embankment or timber used to hold and protect the walls. Any overdepth excavation below such appurtenances that has not been directed will be considered unauthorized and shall be refilled with select bedding material or concrete, as directed by the Contracting Officer, at no additional cost to the Government.

Excavation shall be made accurately to the lines, grades, and elevations indicated. Dimensions and elevations of footings and foundation excavations are only approximate and may be changed if necessary to ensure adequate foundation support. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as indicated. Rock

or other hard foundation materials shall be cleaned of loose debris and cut to a firm surface, either level, stepped, or serrated, as indicated. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before concrete or masonry is to be placed.

3.4.3 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 and 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.

3.4.4 Dewatering

3.4.4.1 Dewatering System

The dewatering system shall be adequate to pre-drain the soils to be excavated to the extent that the piezometric water level in the construction area is a minimum of 2 feet below the bottom of the excavation, side slopes of excavations, or bottom of the footings at all times, or as otherwise required to obtain the specified compaction and installation conditions. Pipeline trenches must be dewatered at least 6 inches below the trench bottom.

In the event of layered soils, the hydrostatic head in the zone below the subgrade elevation shall be relieved to prevent uplift.

Unless otherwise noted and prior to any excavating below or within 2 feet above the groundwater level, a dewatering system shall be placed into operation to lower water levels to the extent specified previously, and then shall be operated continuously 24 hours per day, 7 days a week, until work has been completed to the satisfaction of the Contracting Officer.

Where used, well points shall be installed in an approved manner and in sufficient numbers to provide the necessary removal of water as stated previously. Well points and header piping shall be installed in such a manner that traffic on public thoroughfares and site access roads will not be impeded.

The Contractor shall be solely responsible for the arrangements, locations, and depths of the dewatering system necessary to accomplish the specified work.

To prevent excessive noise, exhaust from all pumps and engines shall be silenced and muffled.

Wellpoint pump discharge shall be controlled to prevent erosion, undermining, and all other damage, and be piped to approved locations.

The Contractor shall comply with any and all applicable regulations and permitting requirements concerning groundwater and discharge.

Excavations shall be kept free from water during the placing of concrete structures and utilities.

3.4.4.2 Observation Wells

The Contractor shall install observation wells as may be required to record accurate water levels.

The Contractor shall be responsible for maintaining wells and observing and recording the elevation of the piezometric water levels daily.

3.4.4.3 Discharge

Discharge of water from dewatering shall be in accordance with contract clause "Dewatering/Consumptive Use Permitting."

3.4.5 Trench Excavation Requirements

Trenches shall be of adequate width and depth for the specified purpose. Side slopes of the trenches shall be as nearly vertical as practicable. Care shall be taken not to overexcavate. Bottoms of the trenches shall be accurately graded to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length except where it is necessary to excavate for bell holes and for proper sealing of pipe joints. Bell holes and depressions for joints shall be dug after the trench bottom has been graded to ensure that the pipe rests on the prepared bottom for as much of its full length as practicable. Bell holes and depressions shall be only of such length, depth, and width as required to make the joint. Stones shall be removed, as necessary, to avoid point bearing. Where rock excavation is required in trenches for pipe, the rock shall be excavated to a minimum overdepth of 6-inches below the trench depth specified. Except as specified for wet or otherwise unstable material, overdepths shall be backfilled with materials specified for backfilling the lower portion of trenches. Whenever wet or otherwise unstable material that is incapable of properly supporting the pipe, as determined by the Contracting Officer, is encountered in the bottom of the trench, it shall be removed and the trench shall be backfilled to the proper grade with coarse sand, fine gravel, or other suitable, approved material.

Trench excavations in surfaced areas shall be by open cut, unless otherwise shown. The pavement shall be cut by concrete saw or other approved method. Cuts shall be in straight lines parallel to the utility line location and shall be to a depth of at least one quarter of the pavement thickness. The remainder of the pavement shall be broken out. Pavement shall be removed a minimum of 12 inches on each side of the trench and 6 inches beyond where the base course is to be removed.

3.4.5.1 Removal of Unstable Material

Where unstable material is encountered 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.

3.4.5.2 Removal of Unsatisfactory Materials

Remove unsatisfactory materials to a horizontal distance of 10 feet beyond the structural element plan and to a vertical depth of not less than 10 feet below the original surface level of the ground in areas designated as structural elements and dry retention ponds. A structural element is a building slab or a foundation.

3.4.5.3 Removal of Unsatisfactory Soil Materials

Unsatisfactory soil materials encountered that extend below the required elevations, as specified under Grubbing Operations shall be excavated to the depth directed by the Contracting Officer.

3.4.5.4 Excavation for Appurtenances

Provide excavation for valve vaults or similar structures sufficient to leave at least 12 inch clear between the outer structure surfaces and the face of the excavation or support members. 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.

3.4.5.5 Excavation for Sanitary Sewers

Ensure that the size of the trench is as shown on the drawings.

For pipe indicated resting on the trench bottom, the bottom of the trench shall be rounded so that the pipe shall nest firmly on undisturbed soil for as nearly the full length of the barrel (as proper jointing operations will permit). This part of the excavation shall be done manually only a few feet in advance of the pipe being laid.

Ensure that the depth of excavation for gravity sewer lines is as existing for replacement of existing gravity sewers and the minimum cover requirement for new gravity sewers and force mains is 3 feet. Ensure that utility separation requirements are as shown on the drawings.

3.4.5.6 Excavation for Water Distribution System

Trenches shall be graded to avoid high points that necessitate placing vacuum and relief valves in the waterlines. If a profile of the pipes is not provided, trenches shall be of a depth to provide a minimum cover over the top of the pipe of 3 feet from the existing ground surface or the indicated finished grade (whichever is lower) unless it is necessary to avoid interference of the waterlines with other utilities. Ensure that utility separation requirements are as shown on the drawings.

3.4.5.7 Excavation for Electrical Utilities

Excavation of trenches for electrical cables and duct lines shall provide

vertical walls, unless otherwise approved by the Contracting Officer, and the trench shall be only as wide as necessary for workers to install the cables or ducts. Abrupt changes in grade of the trench bottom shall be avoided. Trenches shall be of a depth to provide a minimum cover over the top of the cables or ducts of 2-feet below finished grade, unless it is necessary to avoid interference of the electrical cables or ducts with other utilities. Ensure that utility separation requirements are as shown on the drawings.

3.4.5.8 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 Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.4.6 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 the 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 Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.5 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

Notify the Contracting Officer sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. 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.

3.6 SHORING

3.6.1 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.

3.7 GRADING AREAS

Areas within the limits of grading under this section, including adjacent transition areas, shall be uniformly graded. Finished surface shall be smooth within the specified tolerances, compacted, and with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

3.7.1 Grading Outside Building Lines

Areas outside the building lines for each structure shall be graded to drain away from the structure and to prevent ponding of water after rains. Finished surface shall be within the tolerance specified below for each area classification, compacted as specified, and free from irregular surface changes.

Grassed or planted areas:

Finished surface of areas to receive topsoil blend shall be not more than 0.10 foot above or below the indicated finish elevations.

3.8 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. Protect all surfaces from erosion resulting from ponding or water flow.

3.9 GROUND SURFACE PREPARATION

3.9.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, 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 inch, 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.

3.9.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

3.10 UTILIZATION OF EXCAVATED MATERIALS

Dispose of unsatisfactory materials removed 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. 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 by the Contracting Officer. 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.

3.11 BURIED TAPE AND DETECTION WIRE

3.11.1 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.

3.11.2 Buried Detection Wire

Bury detection wire directly above nonmetallic piping at a distance not to exceed 12 inches above the top of pipe. Extend the wire continuously and unbroken from manhole/wet well or manhole/wet well, or to connection with existing system. Terminate the ends of the wire inside the manholes/wet wells at each end of the pipe with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole/wet well. Furnish insulated wire over its entire length. Install wires at manholes/wet wells 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.

3.12 FILLING AND BACKFILLING

3.12.1 Preparations Prior to Backfill Placement

Excavations shall be backfilled as promptly as the work permits but not until completion of the following:

Approval of construction below finish grade

Inspection, testing, approval, and recording location of underground utilities

Removal of concrete formwork

Removal of shoring and bracing; backfilling of voids with satisfactory soil material; temporary sheet piling driven below bottom of structures; and cutting off and removing of utilities in a manner that prevents settlement of the structure or utilities

Removal of trash and debris

Completion of concrete waterproofing

3.12.2 Preparation of Ground Surface to Receive Fill

Vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials shall be removed from ground surface prior to the

placement of fills. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stripped, or broken up in such manner that fill material will bond with the existing material.

When the ground surface has a density less than that specified for the particular area classification, the ground surface shall be broken up, pulverized, moisture-conditioned to near optimum moisture content of the soil material, and compacted to the required depth and percentage of maximum density.

3.12.3 Placement and Compaction

Any structural backfill or fill required for site development should be placed in loose lifts not exceeding 12 inches in thickness and compacted by the use of a vibratory drum roller. If hand-held or track-mounted compaction equipment is used, the lift thickness should be reduced to 6 and 8 inches, respectively. Before compaction, each layer of backfill or fill material shall be moistened or aerated as necessary to provide the optimum moisture content of the soil material and shall then be compacted to the percentage of maximum density for each area classification as specified. Backfill or fill material shall not be placed on surfaces that are muddy, frozen, icy, or contain frost.

Backfill and fill materials adjacent to structures shall be brought up evenly around structures and shall be carried up to the indicated elevations.

Compaction adjacent to structures, within a horizontal distance from the face of the structure equal to the depth of backfill or fill material (measured from the bottom of footing or bottom of foundation or retaining wall) to final grade, shall be done with power-driven hand tampers.

3.12.4 Trench Backfill

3.12.4.1 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 inch loose thickness.

3.13 COMPACTION

3.13.1 Percentage of Maximum Density Requirements

Actual density of each layer of soil material-in-place shall be not less than the following percentages of the maximum density of the same soil material determined by the moisture-density test.

AREA CLASSIFICATION	PERCENT MAXIMUM DENSITY
Grassed areas	95
Walks	95
Utility trenches	95
Structures	
Each layer of back-	

AREA CLASSIFICATION	PERCENT MAXIMUM DENSITY
fill material	98
Building slabs and steps	
Top 12 inches of subgrade and each layer of backfill material	98

3.13.2 Moisture Control

Moisture content in soil material at time of compaction shall be within specified limits.

Where the moisture content of a layer of soil material is below optimum before compaction, the required amount of water shall be uniformly applied to the surface of the layer of soil material and the layer of soil disked or otherwise mixed until a uniform moisture content is reached.

Where the moisture of a layer of soil material is above optimum, it shall be dried.

3.14 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.14.1 Electrical Distribution System

Provide a minimum cover of 36 inches from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.14.2 Pipeline Casing

Provide each new smooth wall steel pipeline casing, where indicated and to the lengths and dimensions shown, complete and suitable for use with the new piped utility as indicated.

3.14.2.1 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.

3.14.2.2 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 end seals as indicated.

3.14.3 Grouting

Distribute grout to place of final deposit and work into place at end of pipe with spades or trowels.

3.15 EMBANKMENTS

3.15.1 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 8 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.

3.16 SUBGRADE PREPARATION

3.16.1 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.

3.16.2 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. Excavate rock encountered in the cut section to a depth of 6 inch below finished grade for the subgrade. 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, do not show deviations for the surface of the subgrade for roadways greater than 1.0 inch when tested with a 10-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.

3.16.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas, compact each layer of the embankment to at least 98 percent of laboratory maximum density.

3.16.3.1 Subgrade for Pavements

As indicated on the drawings.

3.17 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.

3.17.1 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.

3.17.2 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.

3.17.3 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.

3.18 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. 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 Contracting Officer. Determine field in-place density in accordance with ASTM D 1557. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements. 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 75 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM C 136.

3.18.2 In-Place Densities

a. One test per 2,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 2,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

3.18.3 Check Tests on In-Place Densities

If ASTM D 6938 is used, check in-place densities by ASTM D 1556 as follows:

a. One check test per lift for each 2,000 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.

b. One check test per lift for each 2,000 square feet, of fill or backfill areas compacted by hand-operated machines.

3.18.4 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 Contracting Officer.

3.18.5 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 75 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.18.6 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.19 MAINTENANCE

3.19.1 Protection of Graded Areas

Newly graded areas shall be protected from traffic and erosion and shall be maintained free of trash and debris.

3.19.2 Reconditioning Compacted Areas

Where approved compacted areas are disturbed by subsequent construction operations or adverse weather, the surface shall be scarified, reshaped, and compacted as specified to the required density prior to further construction.

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SODDING

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.

FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT)

Section 162 (2010) Prepared Soil Layer

TURFGRASS PRODUCERS INTERNATIONAL (TPI)

TPI GSS (1995) Guideline Specifications to Turfgrass Sodding

1.2 DEFINITIONS

1.2.1 Stand of Turf

100 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

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

Fertilizer

Include physical characteristics, and recommendations.

SD-07 Certificates

Sod farm certification for sods. Indicate type of sod in accordance with TPI GSS.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Sod Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Sod Storage

Lightly sprinkle with water, cover with moist burlap, straw, or other approved covering; and protect from exposure to wind and direct sunlight until planted. Provide covering that will allow air to circulate so that internal heat will not develop. Do not store sod longer than 24 hours. Do not store directly on concrete or bituminous surfaces.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Sod

Place sod a maximum of thirty six hours after initial harvesting, in accordance with TPI GSS as modified herein.

PART 2 PRODUCTS

2.1 SODS

2.1.1 Classification

Argentine Bahia sod shall be well matted with live grass roots. Sod shall be sufficiently thick to hold together during handling operations and to obtain a satisfactory growth of grass. Sod shall be live, fresh, and

uninjured at the time of planting and it shall be the Contractor's responsibility to ensure that it contains sufficient moisture at planting to produce growth. Before the sod is harvested, the grass shall be mowed to the average height normally maintained for that variety of grass and shall have all clippings removed. Presence of weeds or other material which might be detrimental to the proposed planting will be cause for rejection of sod.

2.1.2 Purity

Sod species shall be genetically pure, free of weeds, pests, and disease.

2.2 TOPSOIL

Supply and install topsoil in accordance with FDOT Standard Section 162.

2.3 FERTILIZER

Provide commercial fertilizer of neutral character, with some elements derived from organic sources, containing not less than 8 percent phosphoric acid, 8 percent potassium, and percentage of nitrogen required to provide less than 1 pound of actual nitrogen per 1,000 square feet of area. Provide nitrogen in form that will be available to the seeded and sodded area during initial period of growth. The chemical designation shall be 5-10-10.

Ensure that the fertilizer is delivered to the site in labeled bags or containers.

2.4 WATER

Source of water shall be approved by Contracting Officer and of suitable quality for irrigation containing no element toxic to plant life.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Extent of Work

Provide soil preparation (including soil conditioners), fertilizing, and sodding of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.2 Soil Preparation

Provide 4 inches of off-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.2.1 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the

soils at the job site. For bidding purposes only apply at rates for the following:

Organic Granular Fertilizer 10 to 15 pounds per 1000 square feet.

Synthetic Granular Fertilizer 10 to 15 pounds per 1000 square feet.

3.2 SODDING

3.2.1 Finished Grade and Topsoil

Prior to the commencement of the sodding operation, the Contractor shall verify that finished grades are as indicated on drawings; the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 31 00 00 EARTHWORK.

The prepared surface shall be a maximum 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove from the surface debris and stones over a minimum 5/8 inch in any dimension.

3.2.2 Placing

Place sod a maximum of 36 hours after initial harvesting, in accordance with TPI GSS as modified herein.

3.2.3 Sodding Slopes and Ditches

For slopes 2:1 and greater, lay sod with long edge perpendicular to the contour. For V-ditches and flat bottomed ditches, lay sod with long edge perpendicular to flow of water. Anchor each piece of sod with wood pegs or wire staples maximum 2 feet on center. On slope areas, start sodding at bottom of the slope.

3.2.4 Finishing

After completing sodding, blend edges of sodded area smoothly into surrounding area. Air pockets shall be eliminated and a true and even surface shall be provided. Frayed edges shall be trimmed and holes and missing corners shall be patched with sod.

3.2.5 Rolling

Immediately after sodding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 GRASS ESTABLISHMENT

3.4.1 General

The period of grass establishment shall begin immediately after the completion of sodding in an area and shall continue for a period of 2 months after the completion of sodding on the entire project unless the desired grass cover is established in a shorter period of time and shortening of the grass-establishment is authorized.

3.4.2 Watering

Provide and maintain temporary piping and lawn-watering equipment required to convey water from the water source to uniformly water the grassed areas. Water shall be free from substances detrimental to the growth of vegetation. Water sources located on Government property will be subject to approval prior to use. Temporary water equipment shall be removed after grass area acceptance.

Watering schedules shall be arranged and lawn-watering equipment laid out in a manner to avoid the necessity of walking over muddy and newly grassed areas.

After the initial watering, the grassed areas shall be watered as required to maintain the soil in a moist condition for the entire grass-establishment period.

3.4.3 Mowing

When the average height of grass reaches 2-1/4 inches, seeded lawn areas shall be mowed with approved mowing equipment to a grass height of 1-1/2 inches. When the amount of cut grass is heavy, the cuttings shall be removed to prevent smothering the grass.

When the average height of grass reaches 8 inches, areas shall be mowed with approved mowing equipment to a grass height of 4 inches.

3.4.4 Weeding

Weeds or other undesirable vegetation that threaten to smother the grass shall be uprooted and removed from the area.

3.4.5 Resodding

The area on which an acceptable stand of grass is not present shall be sodded as specified for the original planting. An acceptable stand of living grass from at least 90 percent of the sod placed according to this specification. Areas on which there is not an acceptable stand of grass shall continue to be replanted throughout the following year until an acceptable stand of grass is present.

3.5 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

3.6 ACCEPTANCE REQUIREMENTS

3.6.1 Acceptance Requirements

Completed grass areas shall have been recently mowed and be covered with a uniform stand of the specified grass, be free of rank growths of weeds or other undesirable vegetation, and be free of irregular surface changes and other depressions where water will accumulate.

Scattered bare spots not larger than 6 inches in any dimension will be

allowed, up to a maximum of 3 percent of any grass area.

Condition of grass areas at the time of inspection will be noted and a determination made whether the grass-establishment period shall be extended for any area.

3.6.2 Repairs

If, before completion and final acceptance of the facility, portions of the surface become gullied or otherwise damaged, the grass areas having been destroyed, the affected area shall be repaired to re-establish the condition and grade of the soil prior to sodding and then re-sodded, and the grass established as specified.

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SECTION 33 01 30.72

PROTECTIVE LINING SYSTEM FOR MANHOLE REHABILITATION

PART 1 GENERAL

1.1 WORK INCLUDED

A qualified contractor skilled in the application of the specified systems (Applicator) shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install a protective lining system for manholes that are generally structurally sound to eliminate infiltration/inflow and protect against continuous exposure to hydrogen sulfide and organic acids generated by microbial sources.

Where not otherwise shown, the extent of the protective lining shall be located:

a. Interior walls of manholes to be protected, and

b. Other interior surfaces of structures as noted on drawings and/or noted in written specifications.

Types of protective lining system components for the rehabilitation and corrosion protection work required include, but are not necessarily limited to, the following:

a. Trowelable or sprayable fast setting, high-early strength underlayment.

b. Corrosion-resistant, towel- or spray-applied, polymer, epoxy monolithic protective lining.

c. Elastomeric chimney seal.

d. Cementitious repair mortars.

e. Miscellaneous materials.

The Contractor shall prevent construction debris from falling into the sewer flow line. Cleaning downstream sewers that have been contaminated with construction related debris is the responsibility of the Contractor.

All substrate surface preparation and lining application shall be completed by a manufacturer's approved Applicator.

1.2 RELATED SECTIONS

Other related or referenced sections contained herein are as listed below:

Section 33 30 00	SANITARY SEWERS
Section 31 00 00	EARTHWORK

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.

ASTM INTERNATIONAL (ASTM)

ASTM D 4263	(1983; R 2005) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM F 1869	(2010) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI 03732	(1997) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 1	(1982; R 2004) Solvent Cleaning
SSPC SP 5/NACE No. 1	(2007) White Metal Blast Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning
SSPC VIS 1	(2002) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

A cured sample of the complete protective lining system showing the installed lining system to be expected in the finished work. Show the full thickness, or a typical thickness, when underlayment requirements will vary, of the system with all components in place, except chimney seal, which may be submitted as a separate sample. The protective epoxy lining must be at full thickness. Sample submittals will be reviewed for color, texture, and pattern only. Compliance with all other requirements is the exclusive responsibility of the Applicator.

SD-05 Design Data

Manufacturer's technical data sheets complete with installation instructions for protective lining system required.

SD-06 Test Reports

Structure Sealing Test

Verification from protective lining system manufacturer that all

testing for physical properties was performed in strict accordance with referenced ASTM standards.

SD-07 Certificates

Manufacturer's Materials Warranty Certificate

Manufacturer's certifications that materials have been approved for the installation conditions shown on the drawings and as specified herein.

Statement of Application

Applicator Qualifications

SD-10 Operation and Maintenance Data

Maintenance Manual or Instructions

1.5 QUALITY ASSURANCE

1.5.1 Performance Criteria

Ensure that after receiving the protective lining system the surfaces lined are capable of withstanding, under constant exposure, raw wastewater and are capable of withstanding attack from hydrogen sulfide and organic acids generated by microbial sources, with no adverse effects. Products capable of only intermittent exposure resistance are not acceptable.

1.5.2 Source Quality Control

Provide each component of protective lining system produced by a single manufacturer, including recommended underlayment, fillers, repair products, base coat and top coat materials.

1.5.3 Statement of Application

Upon completion of the work under this Section submit a statement to the Contracting Officer, signed by the protective lining system Applicator, stating that the installed protective lining system complies with the requirements of the Specification and that the installation and materials comply with the manufacturer's printed recommendations related to the condition of installation and use.

1.6 WARRANTIES

Protective lining manufacturer shall warranty its products as free from material defects for a minimum period of 5 years from the date of substantial completion. Submit associated manufacturer's materials warranty certificate.

Applicator shall warranty the installed protective lining system as free from material and workmanship defects for a minimum period of 5 years from the date of substantial completion.

1.7 Delivery, Storage, and Handling

1.7.1 Delivery of Materials

Deliver material in manufacturer's original unopened and undamaged packages.

Clearly identify manufacturer, brand name, contents, and stock number on each package.

Packages showing indications of damage that may affect condition of contents are not acceptable.

1.7.2 Storage of Materials

Store in original packaging under protective cover and protect from damage.

Store all materials at temperatures recommended by manufacturer.

Stack containers in accordance with manufacturer's recommendations.

1.7.3 Handling of Materials

Handle materials in such a manner as to prevent damage to products or finishes.

1.8 QUALIFICATIONS

1.8.1 Applicator Qualifications

The Applicator shall have specific experience in the application of the type of protective lining system specified and shall employ only tradesmen with specific skill and experience in this type of work. Submit name, qualifications, and a list of at least three projects where they have used the specified system to the Contracting Officer for approval.

The Applicator shall be trained and approved by the protective lining materials manufacturer.

1.9 MAINTENANCE MANUAL OR INSTRUCTIONS

When applicable and required by the Contracting Officer, submit copies of the manufacturer's written instructions for recommended maintenance practices including the following information:

a. Product name and number.

b. Name, address, and telephone number of manufacturer and local distributor or representative.

c. Detailed procedures for routine maintenance and cleaning.

d. Detailed procedures for repairs.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Protective Lining System

The protective lining system shall be a multi-component protective lining system, including:

Trowelable or sprayable grade cementitious to provide waterproofing and a smooth, proper substrate for application of the epoxy mortar lining.

Epoxy mortar lining to provide an abrasion resistant and chemical resistant protective lining against the physical and chemical attack phenomena typically associated with municipal wastewater service conditions.

Modified polyamine epoxy as a sealing topcoat over the epoxy mortar lining.

The Applicator shall provide all accessory components such as sealers, infiltration control products, or other compounds or products as recommended by the protective lining manufacturer for maximum protective lining adherence to substrate and long-term service performance.

2.1.2 Cementitious Underlayment

Underlayment shall be a fast-setting, high early strength, Portland-based resurfacing and waterproofing material. Underlayment shall be trowelable formulation for the intended service application. The thickness of the underlayment shall be as required to achieve a smooth, proper substrate for application of the epoxy mortar lining but in no cases shall be less than 1/8-inch thick. Underlayment shall be Sauereisen F-120 Trowel Grade or Tnemec Series 217 Mortarcrete, or approved equal. (For cementitious surfaces eroded less than 1/2-inch Tnemec Series 218 MortarClad, or approved equal, may be used as an alternate.)

2.1.3 Epoxy Mortar Protective Lining

Epoxy mortar protective lining shall be an aggregate-filled, trowel applied polymer protective lining material specifically designed to protect concrete and steel surfaces of manholes and other wastewater structures subjected to municipal wastewater service conditions, including associated abrasive physical attack and chemical attack mechanisms related to hydrogen sulfide and organic acids generated by microbial sources.

Thickness of epoxy mortar protective lining shall be 1/8-inch DFT.

Epoxy mortar protective lining shall be Sewergard 210T or Tnemec Series 434 Perma-Shield H_2S, or approved equal.

2.1.4 Modified Polyamine Epoxy Final Coat

The modified polyamine epoxy final coat shall be a sealing topcoat specifically design to protect concrete and steel surfaces of manholes and other wastewater structures subjected to municipal wastewater service conditions, including associated abrasive physical attack and chemical attack mechanisms related to hydrogen sulfide and organic acids generated

by microbial sources. Thickness of the final coat shall be 15-20 mils DFT.

The modified polyamine epoxy final coat shall be Sewergard Glaze No. 210G or Tnemec Series 435 Perma-Glaze, or approved equal.

2.1.5 Product Manufacturer

Provide one of the following:

Sauereisen, Pittsburgh, PA;
Tnemec Co, Kansas City, MO;
or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

The Applicator shall examine the areas and conditions under which protective lining work is to be performed and notify the Contracting Officer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Contracting Officer.

Commencement of the work of this Section shall indicate that the substrate and other conditions of installation are acceptable to the Applicator and will produce a finished product meeting the requirements of the Specifications. All defects resulting from such accepted conditions shall be corrected by the Applicator at his own expense.

3.1.1 Stopping Active Leaks

Seal all active leaks using Sauereisen InstaPlug No. 2-180, No. 4-370 Chemical Grout, Xypex Patch'n Plug, or approved equal before proceeding with protective lining system installation.

3.2 SURFACE PREPARATION

3.2.1 New Concrete Application

Concrete surfaces to receive protective coating shall be cast with rough form finish. Do not rub, trowel, or otherwise finish surfaces in any manner that will obscure to cover the firm substrate surface. All subsequent surface washing, abrasive blasting, grinding, patching, filling, and preparation shall be completed by the Applicator in accordance with the protective lining manufactures recommendations.

Allow new concrete to cure for 28 days before protective lining system is installed, unless otherwise recommended by the Applicator or protective lining systems manufacturer.

3.2.1.1 Substrate

Concrete surfaces to be coated shall be free of curing compounds and form release agents, laitance, and foreign particles that may inhibit bonding. Before start of protective coating systems application vacuum blast, hydroblast or abrasive blast surfaces to be covered as required and inspect

the substrate. Start of application operations shall indicate acceptance of substrate conditions and full responsibility for the completed work. Surface preparation procedures shall be in accordance with ICRI 03732 or comparably approved method. Surface preparation requirement is to expose aggregate and obtain a uniform surface texture resembling ICRI CSP #4-6 comparators as recommended by the manufacturer for the specific lining material.

Level or grind concrete substrates to protective lining system manufacturer's recommended tolerance to produce a uniform surface profile, including removal of all sharp edges, ridges, or depressions.

3.2.1.2 Voids and Depressions

Fill new concrete voids and depressions with underlayment material reestablishing plan finished grades and surface profiles.

3.2.1.3 Moisture Testing

a. Floors

Install new concrete over a moisture barrier to eliminate moisture transmission through the concrete floor. Before the application of materials, the moisture content shall be determined using a suitable Moisture Detection System in accordance with ASTM F 1869. One such manufacturer is Sealflex Industries, 2925 College Ave. #B4, Costa Mesa, CA. An average value exceeding 3.0 pounds per 1,000 square feet per 24-hour period is unacceptable and will require additional cure time, the application of a surface penetrating vapor barrier or other corrective measures. Retest after taking corrective measure to ensure an average value below 3.0 pounds.

b. Moisture Testing for Walls and Overheads

Test new concrete pours for moisture after completing surface preparation. Use ASTM D 4263. Any indication of moisture will require additional cure time, the application of a surface penetrating vapor barrier, or other corrective measures. Retest after taking corrective measure to ensure the absence of moisture.

Consult protective lining system manufacturer regarding all questions and/or recommendations in reference to moisture problems or questions.

3.2.2 Existing Concrete Application

Existing concrete structure to receive protective lining system shall be capable of withstanding imposed loads. Remove all oil, grease, and chemical contaminants from the surface of the concrete. All surfaces shall be firm, free of damaged or contaminated concrete, laitance, form release agents, and standing water and they shall be structurally sound as determined by the Contracting Officer. Suitable surface preparation methods include shot blasting, abrasive blasting, or hydroblasting. Surface preparation procedures shall be in accordance with ICRI 03732. Surface preparation requirement is to expose aggregate and obtain a uniform surface texture resembling ICRI CSP #4-6 comparators as recommended by the manufacturer for the specific lining material.

3.2.3 Existing Brick Structures Application

Remove all oil, grease, and chemical contaminants from the brick. Hydroblast or abrasive blast to provide anchor profile on brickwork and to remove all existing paints, protective coatings, foreign particles, chemically attacked or unsound mortar and loose brickwork. Loose brickwork and voids in the mortar joints should be repointed with Sauereisen Underlayment No. F-120, Tnemec Series 217 Mortarcrete, or approved equal. Stop all active hydrostatic leaks before protective lining system application.

3.2.4 Metal Application

Remove all visible oils and grease in accordance with SSPC SP 1, Section 2.1. Remove contaminants from surface in accordance with SSPC SP 1 Section 3.2. Using CHLOR*RID INTERNATIONAL "CHLOR*TEST" test kits, or approved equivalent method, determine level of chlorides on the metal surfaces. Level of acceptable chlorides shall be no more than 3µg/cm2 for immersion and no more than 5µg/cm2 for atmospheric conditions. Wash surfaces with unacceptable levels with CHLOR*RID, or approved equal, in accordance with manufacturer's recommendations and then retest.

Using SSPC VIS 1 as a guide, abrasive blast to a SSPC SP 5/NACE No. 1 for immersion and an SSPC SP 10/NACE No. 2 for other service conditions. An anchor profile range of 2.5 to 3.0 mil shall be achieved. All welds shall be continuous, free of flux, and have a smooth rounded radius without any sharp edges or be ground flat and free of flux, fins, and spatter.

Apply two coats of the specified modified polyamine epoxy at 15 to 20 mils per coat using alternating colors between coats.

3.3 APPLICATION

Install protective lining system when ambient air and surface temperature are between 70 and 80 degrees F. Store lining materials within the 60 to 85 degree F range for 48 hours before use. Application and storage temperatures outside this range will require written instruction from the manufacturer.

Application in direct sunlight and/or with rising surface temperatures is not recommended as this may result in blistering of the materials due to expansion of entrapped air or moisture (out-gassing) in the concrete. In such cases, it will be necessary to postpone the application until later in the day when the temperature of the substrate is falling. Concrete surfaces that have been in direct sunlight shall be shaded for at least 24 hours before application and remain shaded until the initial set has taken place. Consult protective lining system manufacturer for application schedule guidelines specific to temperature conditions and possible sealer application recommendations to reduce out-gassing.

3.3.1 Underlayment Application

Use cementitious underlayment products for surface leveling, filling voids, large bugholes, for general concrete patching, and for waterproofing and install and cure according to protective lining system manufacturer's written guidelines as outlined in product technical data sheets or written recommendations specific to the project.

3.3.2 Protective Epoxy Mortar Lining

Apply and cure protective epoxy mortar lining on the properly prepared cementitious underlayment surface in accordance with protective lining system manufacturer's written guidelines as outlined in product technical data sheets. Surface preparation shall include hydroblasting or abrasive blasting to remove all laitance.

3.3.3 Modified Polyamide Epoxy Final Coat

Apply modified polyamine epoxy final coat as a sealing topcoat over the epoxy mortar lining. Apply the modified polyamine epoxy final coat over a properly prepared surface in accordance with the manufacturer's written guidelines as outlined in product technical data sheets.

3.3.4 High Voltage Spark Testing

Test installed protective epoxy lining for pinholes after a minimum 24-hour cure at a temperature of 70 degrees F. Use a Tinker Razor Holiday Detector, San Gabriel, CA, Model AP/W, or an approved equal device for pinhole testing. Apply test voltage of 100 to 125 volts per mil of coating thickness. Mark and repair all pinholes using manufacturer's approved Patch Kit or other approved method.

3.4 ADJUSTMENTS AND CLEANING

At the completion of the work the Applicator shall remove all materials and debris associated with the work of this Section.

Clean all surfaces not designated to receive protective coating. Restore all other work in a manner acceptable to the Contracting Officer.

Protect all finished protective lining work from damage until final acceptance of the work. Repair or replace protective lining that is damaged in any manner at the discretion of the Contracting Officer at no additional cost to the Government.

Clean all protective lining as recommended by the manufacturer to provide finished work acceptable to the Contracting Officer just before final acceptance.

3.5 FINAL ACCEPTANCE

After the specified sealing work has been completed, the manholes/catch basins shall be visually inspected and tested by the Contractor (as required) and found to be acceptable.

3.5.1 Structure Sealing Test

Visually inspect manhole structure sealing for water tightness against leakage of water into the manhole. Repair all visible leaks and defects observed during inspection.

If the groundwater level is not high enough to give a realistic visual inspection the Contracting Officer will require an exfiltration test.

Rework and retest any manholes/catch basins that are leaking, are visually unacceptable in the opinion of the Contracting Officer, or fail the test. The Contracting Officer reserves the right to inspect the sealed structure

during the warranty period. Any leakage or defects in the work found by this inspection shall be corrected by the Contractor within 30 days of notification at no additional cost to the Government.

3.5.1.1 Exfiltration Test

Plug incoming and outgoing sewer and service lines, restrain plugs, and fill the manhole with water to the top of the manhole frame. Allow a soaking period of up to 1 hour if bypassing of the sewage is not required or has been provided for. At the end of this optional soaking period, refill the manhole with water and begin the test.

If the water loss exceeds that shown in the following table, the manhole will have failed the test.

Depth of Manhole	**Maximum Allowable Loss**
Under 8 feet deep	1 inch in 5 minutes
Over 8 feet deep	1/8 inch per foot of depth in 5 minutes

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SECTION 33 01 99

SLIP LINING (CIPP) OF EXISTING PIPING

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 D 790	(2007e1) Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM F 1216	(2009) Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
ASTM F 1743	(2008) Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-In-Place Installation of Cured-In-Place Thermosetting Resin Pipe (CIPP)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9000	(2005) Quality Management Systems - Fundamentals and Vocabulary

1.2 SYSTEM DESCRIPTION

This section consists of the requirements and work needed to rehabilitate existing pipes by furnishing and installing pipe liners by the method of cured in place pipe (CIPP) slip lining. Use pipe liners of the sizes, types, design, and dimensions shown on the plans, and include all connections, joints, and other appurtenances as required to complete the work.

Specified in this section are requirements of CIPP slip lining of existing pipelines, including but is not limited to the following:

Cleaning

Flow diversion and temporary works

CCTV Inspection

Traffic management

Pipe lining fabrication, storage and placement

Service connections, connecting to access chambers and make water tight

Grouting

Testing

Reinstatement

1.2.1 Design Requirements

Provide cured in place pipes designed to allow the maximum conveyance capacity possible.

The CIPP shall be designed as per ASTM F 1216, Appendix X.1. The CIPP design shall assume no bonding to the original pipe wall.

The Contractor must have performed long-term testing for flexural creep of the CIPP pipe material installed. Such testing results are to be used to determine the long-term, time dependent flexural modulus to be utilized in the product design. This is a performance test of the materials (Tube and Resin) and general workmanship of the installation and curing. A percentage of the instantaneous flexural modulus value (as measured by ASTM D 790 testing) will be used in design calculations for external buckling. The percentage, or the long-term creep retention value utilized, will be verified by this testing. Retention values exceeding 50% of the short-term test results shall not be applied unless substantiated by qualified third party test data to the Government's satisfaction. The materials utilized for the contracted project shall be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in the CIPP design.

The Enhancement Factor 'K' to be used in 'Partially Deteriorated' Design conditions shall be assigned a value of 7. Application of Enhancement (K) Factors in excess of 7 shall be substantiated through independent test data to the satisfaction of the Government.

The layers of the CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If the layers separate during field sample testing, new samples will be required to be obtained from the installed pipe. Any reoccurrence may cause rejection of the work.

The CIPP material for pipes up to 24-inch diameter shall conform to the structural properties, as listed below. For pipe diameters over 24 inches, use liner and resin calculation for I Plus composite as developed In Situ Form Technologies, Inc. or approved equal.

MINIMUM CIPP PHYSICAL PROPERTIES

Property	Test Method	Cured Polyester Composite	
		Min per ASTM F 1216	Enhanced Resin
Modulus of Elasticity	ASTM D 790	250,000 psi	400,000 psi

Property	Test Method	Cured Polyester Composite	
		Min per ASTM F 1216	Enhanced Resin
Flexural Stress	ASTM D 790	4,500 psi	4,500 psi

The required structural CIPP wall thickness shall be based 6 mm.

1.2.2 Performance Requirements

Notify the Contracting Officer 24 hours in advance of tests, and perform tests at the work site if practicable. Conform to local, state, and federal requirements.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

List of proposed subcontractors; G
List of proposed products; G
Construction Progress Schedule; G
Manufacturer's Certification of Florida Product Approval

SD-02 Shop Drawings

Survey of Pipe Locations

Submit manufacturer's detailed product data with complete information on pipeline materials, physical properties, and dimensions. Include a manufacturer's certificate of compliance with specifications for proposed materials.

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Cured in Place Pipes

SD-06 Test Reports

After liner installation, perform a hydrostatic test in accordance with ASTM F 1216 before the liner has been completely sealed into place. Check integrity of joints and verify that liner has not been damaged during installation. Repair if needed using liner manufacturer's recommended procedure and retest for leaks.

SD-08 Manufacturer's Instructions

Manufacturer's recommendations for shipping, handling, erection procedures, and care and maintenance upon completion of installation.

SD-09 Manufacturer's Field Reports

Manufacturer's Certification of Installation

1.4 QUALITY ASSURANCE

1.4.1 Survey of Pipe Locations

Submit a certified survey meeting the requirements specified herein.

1.4.2 Qualifications

Products and Installers must meet all of the following criteria to be deemed Commercially Acceptable:

For a Product to be considered Commercially Proven, a minimum of 1,000,000 linear feet or 4,000 manhole-to-manhole line sections of successful wastewater collection system installations in the U.S. must be documented to the satisfaction of the Government to assure commercial viability

For an Installer to be considered as Commercially Proven, the Installer must satisfy all insurance, financial, and bonding requirements of the Government, and must have had at least 5 (five) years active experience in the commercial installation. In addition, the Installer must have successfully installed at least 50,000 feet of the product bid in wastewater collection systems. Acceptable documentation of these minimum installations must be submitted to the Government.

Sewer rehabilitation products submitted for approval must provide third party test results supporting the structural performance (short-term and long-term) of the product and such data shall be satisfactory to the Government. Test samples shall be prepared to simulate installation methods and trauma of the product. No product will be approved without independent third party testing verification.

Both the rehabilitation manufacturing and installation processes shall operate under a quality management system which is third-party certified to ISO 9000 or other recognized organization standards. Proof of certification shall be required for approval.

All required submittals must be satisfactory to the Government.

1.4.3 Pre-Installation Conference

At the Pre-installation conference provide, for approval, submit the following:

a. List of proposed products showing existing pipe diameters, with samples of the liner and resins

b. List of measured pipe diameters of each sewer segment to be lined with CIPP

c. Dates of liner placement,

d. Proposed Construction Progress Schedule

e. List of proposed subcontractors

f. Manufacturer's Certification of Florida Product Approval

1.5 DELIVERY, STORAGE, AND HANDLING

Prevent injury or abrasion to CIPP during loading, transportation, and unloading.

1.6 SEQUENCING AND SCHEDULING

Submit plan for final approval of construction sequence and schedule prior to commencing construction.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Tube

The sewn tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of ASTM F 1216, Section 5.1 or ASTM F 1743, Section 5.2.1 The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, and stretch to fit irregular pipe sections.

The wet out tube shall have a relatively uniform thickness so that when compressed at installation, pressures will equal or exceed the calculated minimum design thickness.

The tube shall be manufactured to a size that when installed will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during inversion. Overlapped layers of felt in longitudinal seams that cause lumps in the final product shall not be utilized.

The outside layer of the tube shall be coated with an impermeable, flexible membrane that will contain the resin and all the resin impregnation (wet out) procedure to be monitored.

The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No material shall be included in the tube that may cause delamination in the cured CIPP. No dry or unsaturated layers shall be evident.

The wall color of the interior pipe surface of CIPP after installation shall be a relatively light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.

Seams in the tube shall be stronger than the non-seamed felt material.

The tube shall be marked for distance at regular intervals along its entire length, not to exceed 5 feet. Such markings shall include the Manufacturers name or identifying symbol. The tubes must be manufactured in the United States. Liner materials shall be as manufactured by In situ Form Technologies, Inc. or approved equal.

2.1.2 Resin

The resin system shall be a corrosion resistant polyester, vinyl ester, or epoxy system including all required catalysts, initiators or hardeners that when cured within the tube create a composite that satisfies the requirements of ASTM F 1216 and ASTM F 1743, the physical properties herein, and those which are to be utilized in the design of the CIPP for this project. The resin shall produce a CIPP that will comply with the structural and chemical resistance requirements of this specification.

PART 3 EXECUTION

3.1 PREPARATION

Complete the following preparations, unless approved otherwise by the Contracting Officer. The Contracting Officer makes no guarantee regarding the information, data, and physical condition of underground facilities or existing pipe lines. Before commencing with any work, or ordering any materials, physically measure and perform CCTV inspection of the existing pipe line to verify that the rehabilitation specified herein is appropriate.

3.1.1 Safety

Carry out all operations in strict accordance with all applicable OSHA Standards. Particular attention is directed to those safety requirements involving entry into a confined space. It is the Contractor's responsibility to familiarize themselves with OSHA Standards and Regulations pertaining to all aspects of the work.

It shall be the responsibility of the Government to locate and designate all manhole access points open and accessible for the work, and provide rights-of-access to these locations. If a street must be closed to traffic because of the orientation of the sewer, the Government shall institute the actions necessary to provide access during this for the mutually agreed time period. The Government shall also provide free access to water hydrants for cleaning, installation and other process related work items requiring water.

3.1.1.1 Cleaning of Sewer Lines

The Contractor shall perform internal pipe cleaning no more than 48 hours before lining and remove all internal debris out of the sewer line that will interfere with the installation of CIPP. The Government shall also provide a dumpsite for all debris removed from the sewers during the cleaning operation. Unless stated otherwise, it is assumed this site will be at or near the sewage treatment facility to which the debris would have arrived in absence of the cleaning operation. Any hazardous waste material encountered during this project will be considered as a changed condition.

3.1.1.2 Bypassing Sewage

The Contractor shall provide for the flow of sewage around the section or sections of pipe designated for repair. All service laterals in the line or line sections being lined shall be addressed as part of the bypass plan. The pump(s) and bypass line(s) shall be of adequate capacity to accommodate the sewage flow. The Government shall require a detailed bypass plan to be submitted.

3.1.1.3 Inspection of Pipelines

Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles and service connections using close circuit television (CCTV) inspection techniques. The pipeline interior shall be carefully inspected to determine the location of any conditions that may prevent proper installation of CIPP. These shall be noted and corrected. A DVD or videotape and suitable written log for each line section shall be submitted for later reference by the Government.

3.1.1.4 Line Obstructions

It shall be the responsibility of the Contractor to clear the line of obstructions such as solids and roots that will prevent the insertion of CIPP. If pre-installation inspection reveals an obstruction such as a protruding service connection, dropped joint, or a collapse that will prevent the installation process, that was not evident on the pre-bid video and it cannot be removed by conventional sewer cleaning equipment, then the Contractor shall make a point repair excavation to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the Government's representative prior to the commencement of the work and shall be considered as a separate pay item.

3.1.1.5 Public Notification

The Contractor shall make every effort to maintain sewer service usage throughout the duration of the project. In the event that a connection will be out of service, the longest period of no service shall be 8 hours. A public notification program shall be implemented, and shall as a minimum, require the Contractor to be responsible for contacting each affected facility connected to the sanitary sewer and informing them of the work to be conducted, and when the sewer will be off-line. The Contractor shall also provide the following:

Written notice to be delivered to each affected facility the day prior to the beginning of work being conducted on the section, and a local telephone number of the Contractor they can call to discuss the project or any potential problems.

Personal contact with any home or business, which cannot be reconnected within the time stated in the written notice.

The Contractor shall be responsible for confirming the locations of all branch service connections prior to installing the CIPP.

3.2 INSTALLATION

CIPP installation shall be in accordance with ASTM F 1216, Section 7, or ASTM F 1743, Section 6, with the following modifications:

Resin Impregnation - The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin during installation through cracks and irregularities in the original pipe wall.If a vacuum impregnation process is used, the point of vacuum shall be no further than 25-feet from the point of initial resin introduction. After vacuum in the tube is established, a vacuum point shall be no further than 75-feet from the leading edge of the resin. The leading edge of the resin slug shall be as near to

perpendicular to the longitudinal axis of the tube as possible. A roller system shall be used to uniformly distribute the resin throughout the tube. If the Installer uses an alternate method of resin impregnation, the method must produce the equivalent results. Any alternate resin impregnation method must be documented to the Government's satisfaction that the saturation of the CIPP is sufficient.

Tube Insertion - The wet out tube shall be positioned in the pipeline using either inversion or a pull-in method. If pulled into place, a power winch should be utilized and care should be exercised not to damage the tube as a result of pull-in friction. The tube should be pulled-in or inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.

Temperature gauges shall be placed between the tube and the host pipe's invert position to monitor the temperatures during the cure cycle.

Curing shall be accomplished by utilizing hot water under hydrostatic pressure or steam pressure in accordance with the manufacturer's recommended cure schedule.

3.3 REINSTATEMENT OF BRANCH CONNECTIONS

It is the intent of these specifications that branch connections to buildings be re-opened without excavation, utilizing a remotely controlled cutting device, monitored by a CCTV. Restore 95 percent of the opening, retrieve coupons, and smooth opening. The Contractor shall certify a minimum of two complete functional cutters plus key spare components are on the job site before each installation or are in the immediate area of the jobsite and can be quickly obtained. Unless otherwise directed by the Government or his authorized representative, all laterals will be reinstated. No additional payment will be made for excavations for the purpose of reopening connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work.

3.4 INSPECTION

CIPP samples shall be prepared and physical properties tested in accordance with ASTM F 1216 or ASTM F 1743, Section 8, using either method proposed. The flexural properties must meet or exceed the values listed in Table 1 of the applicable ASTM.

Wall thickness of samples shall be determined as described in paragraph 8.1.6 of ASTM F 1743. The minimum wall thickness at any point shall not be less than 87.5 percent of the minimum design wall thickness of 6 mm.

Visual inspection of the CIPP shall be in accordance with ASTM F 1743, Section 8.6.

Post-lining internal television inspection shall be performed within 24 hours of CIPP curing. All defects located shall be repaired as approved by the Government. A DVD or videotape of the internal inspection shall be submitted before line section identification.

3.5 TESTING REQUIREMENTS

3.5.1 Chemical Resistance

The CIPP shall meet the chemical resistance requirements of ASTM F 1216, Appendix X2. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical-testing requirements.

3.5.2 Hydraulic Capacity

Overall, the hydraulic cross-section shall be maintained as large as possible. The CIPP shall have a minimum of the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition.

3.5.3 CIPP Field Samples

When requested by the Government the Contractor shall submit test results from field installations in the USA of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties specified in Minimum CIPP Physical Properties table in the paragraph titled "Design Requirements" have been achieved in previous field applications. Samples for this project shall be made and tested as described in the article titled "INSPECTION."

3.6 CLEAN-UP

The work area shall be maintained and kept clean throughout the work. Upon acceptance of the installation work and testing, the Contractor shall restore the project area affected by the operations to a condition at least equal to that existing prior to the work.

3.7 INSTALLATION CERTIFICATION

Submit a signed copy of the Manufacturer's Certification of Installation to the Contracting Officer upon completion of final inspection.

-- End of Section --

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SECTION 33 11 00

WATER DISTRIBUTION

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.

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2008) Performance Requirements for Atmospheric Type Vacuum Breakers
ASSE 1011	(2004; Errata 2004) Performance Requirements for Hose Connection Vacuum Breakers
ASSE 1012	(2009) Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent
ASSE 1013	(2009) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
ASSE 1020	(2004; Errata 2004; Errata 2004) Performance Requirements for Pressure Vacuum Breaker Assembly

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C605	(2005) Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains
AWWA C800	(2005) Underground Service Line Valves and Fittings

ASME INTERNATIONAL (ASME)

ASME A112.1.2	(2004) Standard for Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)

ASTM INTERNATIONAL (ASTM)

ASTM B 61	(2008) Standard Specification for Steam or Valve Bronze Castings

ASTM B 62	(2002) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM D 1238	(2004c) Melt Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D 1784	(2007) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2464	(2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2467	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION (FDEP)

FAC 62-555.340	(2003) Disinfection and Bacteriological Evaluation of Public Water System Components

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

UPC	(2003) Uniform Plumbing Code

JOHN F. KENNEDY SPACE CENTER (KSC)

KNPR 8500.1	KSC Environmental Requirements

NSF INTERNATIONAL (NSF)

NSF 14	(2003) Plastics Piping System Components and Related Materials
NSF 61	(2009) Drinking Water System Components - Health Effects

1.2 DESIGN REQUIREMENTS

1.2.1 Water Service Lines

Provide water service lines indicated as 1 inch lines from water distribution main to lift station hosebibb at the point indicated. Water service lines shall be polyvinyl chloride (PVC) plastic pipe or as indicated. 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.

1.3 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-02 Shop Drawings

The following drawing types shall be submitted in accordance with paragraph entitled, "Shop Drawings," of this section.

As-Built Drawings; G

SD-03 Product Data

Manufacturer's instructions and catalog data shall be submitted for the following items:

Pipe Connections; G
Appurtenances; G
Water Service Line; G
Polyvinyl Chloride (PVC) Pressure Pipe; G
PVC Fittings; G
Unions; G
Valve Boxes; G
Corporation; G
Backflow Preventer Assemblies; G
Service Saddles; G

SD-06 Test Reports; G

Test reports for the following items shall be submitted in accordance with the paragraphs entitled, "Testing" of this section.

Pressure Test; G
Leakage Test; G
Disinfection; G
Test of Backflow Prevention Assemblies

SD-08 Manufacturer's Instructions

Backflow Preventer Assemblies

1.4 SHOP DRAWINGS

As-built drawings are required for all systems and will be prepared by a surveyor registered in the State of Florida. As-built drawing shall contain the following information:

Location of valves and fittings.

Elevation of top of water line at all utility crossings.

Separation between other utilities within 10 feet horizontally.

Material used.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 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 and jointing materials under cover out of direct sunlight. Do not exceed the manufacturer's recommended stacking height during storage. Do not store materials directly on the ground. Keep inside of pipes, fittings, and valves, free of dirt and debris.

1.5.2 Handling

Pipe and accessories shall be handled to ensure delivery to the trench in an undamaged condition. Particular care shall be taken not to injure the pipe coating. When the coating or lining of any pipe or fitting is damaged, the Contractor shall repair at his expense in an approved manner. No other pipe or material shall be placed inside of a pipe or fitting after the coating has been applied. Pipe shall be carried into position. Pinch bars and tongs for aligning or turning the pipe shall be used only on the bare ends of the pipe. Interiors of pipe and accessories shall be cleaned before the pipe or accessories lowered into the trench and shall be kept clean during laying operations by an 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 cost to the Government.

PART 2 PRODUCTS

Newly installed or constructed Public Water System (PWS) components that come into contact with drinking water or drinking water treatment chemicals shall conform to NSF 61 or Section 6 of NSF 14.

Any pipe and pipe fitting used in the construction, alteration, or repair of any PWS shall be lead free (contain not more than 8% lead). Any plumbing fitting or fixture that is intended to dispense water for human consumption and that is used in the construction, alteration or repair of any PWS shall be lead free (in compliance with Section 9 of NSF 61 as adopted in Rule 62-555.335 F.A.C.).

All water main pipes, including fittings, shall be color coded or marked using blue as a predominant color to differentiate drinking water from reclaimed or other water. Underground metal pipe shall have blue stripes applied to the pipe wall. Pipe striped during manufacturing of the pipe shall have continuous stripes that run parallel to the axis of the pipe, that are located at no greater than 90-degree intervals around the pipe, and that will remain intact during and after installation of the pipe. If tape or paint is used to stripe pipe during installation of the pipe, the tape or paint shall be applied in a continuous line that runs parallel to the axis of the pipe and that is located along the top of the pipe.

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

All materials in contact with potable water shall be NSF 61 approved and shall be suitable for use with chloraminated water.

2.1.1.1 3-Inch and Smaller Polyvinyl Chloride (PVC) Pressure Pipe

Provide pipe that is Schedule 80, Type I, Grade 1 (Class 12454-B), conforming to ASTM D 1784 and ASTM D 1785.

Provide pipe that bears the NSF logo for potable water use.

2.1.1.2 3-Inch and Smaller PVC Fittings

Provide fittings that are Schedule 80 and conform to ASTM D 2464 for threaded fittings and ASTM D 2467 for socket-type fittings.

2.1.1.3 3-Inch and Smaller PVC Pipe Joints

Provide socket welded pipe and fitting joints except where threaded and flanged joints are required to connect to valves and equipment.

2.1.1.4 3-Inch and Smaller PVC Pipe Unions

Provide unions with socket-type ends, Viton O-rings, and are Schedule 80. Ensure that material is Type I, Grade 1 PVC in accordance with ASTM D 1784.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Backflow Preventer Assemblies

Backflow prevention devices must be approved by the State or local regulatory agencies. If there is no State or local regulatory agency requirements, the backflow prevention devices must be listed by the Foundation for Cross-Connection Control & Hydraulic Research, or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention devices and assemblies.

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be meet the above requirements.

Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.1.2.2 Valve Boxes

Valve boxes shall be cast iron, complete with lock-type covers requiring a special wrench for removal. Cast-iron boxes shall be the extension type with screw or slide adjustments and with flared bases. Concrete boxes shall be constructed in accordance with details indicated. The word "WATER" shall be cast in the cover. Boxes shall be installed over each gate valve. Boxes shall be of such a length as can be adapted, without full extension, to the depth of cover required over the pipe at the valve location. Concrete boxes may be installed only in locations not subjected to traffic.

2.1.2.3 Unions

No attempt has been made to show all unions required for the project. The

Contractor shall provide unions at all connections of threaded pipe to installed equipment unless deleted by the Contracting Officer, in writing, at certain locations. The unions shall meet or exceed the quality of materials, pressure rating, service, and painting requirements of connected piping.

2.1.2.4 Warning Tape and Tracing Wire for Buried Piping

Warning tape and tracing wire for buried pipe is specified under Section 31 00 00 EARTHWORK.

2.1.2.5 Water System Identification Tags

Provide a coordinated system of piping and equipment identification which includes metal-tag-identified major valves, piping-system components, and equipment.

Install identification tags made of stainless steel and indicating function of valve or similar component on such system devices. Tags shall be not less than 2 inches in diameter and the marking shall be stamped.

Provide equipment with metal identification tags bearing an equipment designation number provided by the Government and matching the drawing designations.

Secure tags to valve or equipment items with 12-gage galvanized wire.

2.1.2.6 Tracer Wire for Nonmetallic Piping

Tracer wire for nonmetallic piping is specified under Section 31 00 00 EARTHWORK.

2.1.2.7 Polyethylene Bagging

Polyethylene bagging for buried ductile iron pipe, fittings, and valves shall be 8 mils thickness minimum polyethylene, manufactured in accordance with ASTM D 1238, Type I, Class C, Grade E1.

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Water Service Line Appurtenances

2.2.1.1 Service Saddles

Service saddles shall be epoxy coated ductile iron bodied suitable for use with PVC water main and corporation cocks specified. Saddles shall be double strap design complete with cemented-in-place O-Ring gaskets and full length threaded boss. Saddles shall have stainless-steel type straps; Clamping arrangement which is not fully contoured to the outside diameter of the pipe, or lugs which dig into the pipe or a saddle which distorts the pipe are not acceptable. Saddles shall be rated for leak free operation at a minimum of 200 psi and shall be as manufactured by Mueller Co, or approved equal.

2.2.1.2 Corporation

Corporation (through 2-1/2 inches in diameter) shall be manufactured from cast bronze with machined fitting surfaces and in accordance with AWWA C800. Corporation shall withstand a minimum working pressure of 200 psi. The

inlet and outlet connections shall be coordinated to connect to the adjoining equipment, tubing, piping, couplings, unions, adapters, reducers, etc. by the Contractor. The inlet and outlet size shall be the same. The corporation outlet shall have the required all-bronze adapters, unions, reducers, bushings, or couplings to properly secure to the adjacent items and appurtenances. Corporation shall be Model FB series as manufactured by Ford Meter Box Company, Inc., or approved equal. Each corporation shall be furnished with a solid bronze square-head plug for plugging the corporation outlet. Ford stainless-steel insert stiffeners shall be used as required for connection to tubing, PVC pipe, HDPE pipe, or as required.

2.2.1.3 Curb or Service Stops

Ground key, round way, inverted key type; made of bronze, ASTM B 61 or ASTM B 62; 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.

2.2.1.4 Curb Boxes

Provide a curb box for each curb or service stop. Curb boxes shall be of cast iron of a size suitable for the stop on which it is to be used. Provide a round head. Cast the word "WATER" on the lid. Each box shall have a heavy coat of bituminous paint.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

3.1.1.1 Cutting Of Pipe

Cutting of pipe shall be done without damage to the pipe. Cutting shall be done with an approved mechanical cutter. Wheel cutters shall be used when practical.

3.1.1.2 Location

New or relocated, underground water mains shall be laid to provide a horizontal distance of at least 3 feet between the outside of the water main and the outside of any existing or proposed storm sewer and at least 6-1/2 feet (preferably 10 feet) between the outside of the water main and the outside of any existing or proposed gravity- or pressure-type sanitary sewer. The minimum horizontal separation distance between water mains and gravity-type sanitary sewers may be reduced to 3 feet where the bottom of the water main is laid at least 18 inches above the top of the sewer.

New or relocated, underground water mains crossing any existing or proposed gravity-type sanitary sewer or storm sewer shall be laid so the outside of the water main is at least 18 inches above or at least 18 inches below the outside of the other pipeline.

New or relocated, underground water mains crossing any existing or proposed pressure-type sanitary sewer shall be laid so the outside of the water main is at least 18 inches above or below the outside of the other pipeline. It is preferable to lay the water main above the other pipeline.

At utility crossings, one full length of water main pipe shall be centered

so the water main joints will be as far as possible from the other pipeline. Alternatively, at such crossings, the pipes shall be arranged so that all water main joints are at least 3 feet from all joints in storm sewers and at least 6.5 feet from all joints in gravity- or pressure-type sanitary sewers.

3.1.1.3 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.1.1.4 Placing, Laying and Pipe Connections

Pipe and accessories shall be carefully lowered into the trench by suitable equipment. Under no circumstances shall materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Poles used as levers for removing skids across trenches shall be made of wood and have broad flat faces to prevent damage to the pipe or coating. Except where necessary in making connections with other lines or as authorized, pipe shall be laid with the bells facing upstream. Full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that foreign material will not enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor in an approved manner, at no additional expense to the Government.

Where connections are made between new work and existing mains, the connections shall be made by using special sections and fittings to suit the actual conditions. Where made under pressure, connections shall be installed in accordance with the recommendations of the manufacturer of the pipe being tapped.

3.1.1.5 Couplings And Joints

Installation of couplings, mechanical joints, and flanged joints shall be in accordance with the manufacturer's recommendations. Pipe Connections between different types of pipe and accessories shall be made with transition fittings as recommended by the manufacturer.

3.1.1.6 Installation of Tracer Wire

Where nonmetallic pipe is used, install a single conductor #6 gauge thick wire with Type TW insulation above the pipe to facilitate pipe location.

3.1.1.7 Locating Devices

For all subsurface elbows, tees, and valves, embed the device into the top surface on the thrust block such that half the device is exposed and the location is at the centroid of the thrust block top surface area. The locating devices shall be Omni Marker Model 161 Water Marker or approved equal.

3.1.2 Installation of Water Service Piping

3.1.2.1 Service Line Connections to Water Mains

Connect service lines 1 inch size to the main by a corporation stop and install a service stop below the frostline as indicated. Connect service lines to PVC water mains in accordance with AWWA C605 for service taps.

3.1.3 Installation of Backflow Preventer Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with UPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.2 TESTING -- PVC PIPE AND FITTINGS

3.2.1 Pressure Test

After the pipe is laid, the joints completed, and the trench backfilled, the newly laid piping or any valved section of piping shall be subjected for 1 hour to a hydrostatic-pressure test of 150 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, and valves shall be carefully examined during the open-trench test. Joints showing visible leakage shall be replaced or remade as necessary. Leaking rubber gasketed joints shall be remade using new gaskets when necessary. Pipe, mechanical joints, fittings, or valves discovered to be cracked or defective as a consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are approved.

3.2.2 Leakage Test

Leakage tests shall be conducted concurrently with the pressure test. Duration of each leakage test shall be at least 2 hours. During the test, the main shall be subjected to a pressure of 150 psi. Leakage is defined as the additional quantity of water supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage volume is defined by the formula:

$$L = \frac{SD(P)^{1/2}}{C}$$

in which:

L = allowable leakage (gallons)
S = length of pipe tested (feet)
D = diameter of the pipe (inches)
P = specified test pressure (psig)
C = 133,200

Allowable leakage in gallons per hour per 1,000 feet of pipeline shall be as follows:

PIPE DIAMETER (INCHES)	ALLOWABLE LEAKAGE (GALLONS PER HOUR)
4	0.37
6	0.55
8	0.74
10	0.92
12	1.10
14	1.29
16	1.47

Allowable leakage in gallons per hour not exceed 5 percent of total system pressure.

3.2.3 Test Timing

Except where concrete-reaction backing necessitates a 72-hour delay, pipelines jointed with rubber gaskets, mechanical, or bolted joints may be subjected to hydrostatic pressure, inspected, and tested for leakage after partial completion of backfill.

3.2.4 Retesting

Before permanent paving is placed over the pipeline, a measured leakage test of the entire pipeline shall be required. Leakage loss shall be within approved tolerances.

3.2.5 Sterilizing

Water piping, including valves, fittings, and other devices, shall be sterilized and tested according to AWWA C651. After successful sterilization, the piping shall be flushed before placing into service. Water for sterilization will be furnished by the Government, but disposal shall be the responsibility of the Contractor.

3.3 TEST OF BACKFLOW PREVENTION ASSEMBLIES

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow preventer assemblies.

Backflow prevention assembly test gauges shall be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements,

gauges shall be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.4 WATER MAIN TAPS/SADDLES

The existing distribution system shall be protected from backflow contamination during filling for pressure testing, flushing, disinfection, and final connections in accordance with AWWA C651. A 2 inch jumped connection bypassing the tie-in valve with an approved double-check valve or approved backflow prevention device shall be used for filling the new water main. The tie-in valve shall be closed and secured by a locking mechanism until flushing of the new water main occurs.

Prior to installing a service saddle, the KSC Pollution Control and Sanitation Officer (PCSO), or designated representative, must be contacted to monitor the installation. The exterior surface of the main to be tapped shall be thoroughly cleaned. Once the sleeve is securely attached to the main, the sleeve shall be filled with a hypochlorite solution and hydrostatically tested at 200 psi for a minimum of 15 minutes with no loss of pressure or sign of leakage. During the tapping process, the interior surface of the sleeve and the surface being tapped shall be in direct contact with the hypochlorite. After the tapping procedure is complete, flush the line to remove metal bits and debris.

All connections to existing work shall be in accordance with AWWA C651 for protection of existing main from contamination by the new line during filling, flushing and testing.

3.5 DISINFECTION CRITERIA FOR KSC POTABLE WATER SYSTEM INSTALLATION, REPAIR, OR MODIFICATION TO WATER MAINS

The KSC Pollution Control and Sanitation Officer (PCSO) or designated representative shall approve the disinfection procedure to be used and be present during the process. A minimum of 24 hours lead time is required to schedule attendance of disinfection by PCSO or representative. Contact should be made through the Construction Management Office. Ensure proper disinfection protocol/bacteriological sampling occurs if water line is broken, tapped, modified, or if loss of pressure occurs. All repaired, modified or newly installed water system components shall be disinfected after pressure and leak tests have been performed. All existing mains closed for outage shall be disinfected and tested prior to use. The system

components to be disinfected shall be thoroughly flushed with potable water before introducing the chlorinating solution. This flushing is required to remove all debris from the systems components. The chlorinating solution shall provide a dosage of not less than 50 parts per million (ppm). The chlorine solution shall be introduced into the water line in an approved manner and be evenly distributed throughout the entire affected systems components long enough to destroy all non-spore forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and tests shall reveal not less than 25 ppm of chlorine residual after the 24 hour retention period. The line shall be flushed with potable water until the residual chlorine level is reduced to less than 1.0 ppm or to the normal background level in the area. Discharge of highly chlorinated water from disinfection shall be coordinated with EG&G Water and Wastewater. Samples will be collected by the Contractor or designated representative from several points in the water system for bacteriological examination. The system will remain closed and will not be accepted for use until two consecutive days of satisfactory bacteriological results have been obtained and approval has been given by the PCSO and regulatory agencies.

Taps, modification, repairs, or new lines added to the system shall be tested and disinfected following AWWA C651 and KNPR 8500.1. Successful disinfection shall be demonstrated by bacteriological testing following FAC 62-555.340(1) and FAC 62-555.340(2).

3.6 DISPOSING OF HEAVILY CHLORINATED WATER

The environment to which chlorinated water may be discharged shall be inspected by the Contractor, and, if there is any question that the chlorinated discharge will cause damage to personnel or the environment, then a reducing agent shall be applied to the water (reference Appendix B of the current AWWA C651 for neutralizing chemicals). Such discharges should be coordinated with the KSC PCSO, or designated representative.

3.7 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 30 00

SANITARY SEWERS

PART 1 GENERAL

1.1 RELATED SECTIONS

The provisions of other sections of the General and Supplementary Conditions are fully applicable to this Section as if incorporated herein.

Other related or referenced sections contained herein are as listed below:

Section 03 01 30.71	CONCRETE REHABILITATION
Section 03 30 00	CAST-IN-PLACE CONCRETE
Section 03 40 00.00 10	PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION
Section 31 00 00	EARTHWORK
Section 33 01 99	SLIPLINING (CIPP) OF EXISTING PIPING
Section 33 30 00	SANITARY SEWERS

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.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI C1012	(2007; Errata 2009) Ductile Iron or Malleable Iron for 1/2-inch thru 1-1/2-inch

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C105/A21.5	(2005) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10	(2008) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2005) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C150/A21.50	(2002; Errata 2003) Thickness Design of Ductile-Iron Pipe
AWWA C151/A21.51	(2002; Errata 2002) Ductile-Iron Pipe, Centrifugally Cast, for Water

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996; R 2005) Square and Hex Bolts and

	Screws (Inch Series)
ASME B18.21.1	(1999; R 2005) Lock Washers (Inch Series)
ASME B18.22.1	(1965; R 2008) Plain Washers
ASME B18.6.1	(1981; R 2008) Wood Screws (Inch Series)
ASME B18.6.3	(2003; R 2008) Machine Screws and Machine Screw Nuts
ASME SA-36	(1998) Steel Designations
ASME SA-675	(1998) Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 27/A 27M	(2008) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2009) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 47/A 47M	(1999; R 2009) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 489	(2004e1) Standard Specification for Carbon Steel Lifting Eyes
ASTM A 513	(2008a) Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
ASTM A 563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 635/A 635M	(2009b) Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for
ASTM B 633	(2007) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

ASTM C 478	(2008) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM D 2680	(2001) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 3034	(2008) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM E 488	(1996; R 2003) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F 1554	(2007a) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F 436	(2009) Hardened Steel Washers
ASTM F 593	(2002; R 2008) Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F 594	(2008) Standard Specification for Stainless Steel Nuts
ASTM F 714	(2008) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 879	(2010) Standard Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws
ASTM F 1417	(1992; R 2005) Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air

1.3 SYSTEM DESCRIPTION

1.3.1 Sanitary Sewer Gravity Pipeline

Provide new exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 5 feet outside of building walls.

1.3.2 Sanitary Sewer Pressure Lines

Provide pressure lines of high density polyethylene (HDPE) pipe.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor shall record Existing Conditions prior to starting work in accordance with the paragraph entitled, "Project/Site Conditions," of this section.

Submit method of testing in accordance with the paragraph entitled "Gravity Piping."

SD-02 Shop Drawings

The following shall be submitted by the Contractor in accordance with paragraph entitled "Drawings" of this section.

Drawings; G

Installation and as-built drawings, as specified.

SD-03 Product Data

Pipeline materials; G
Pipeline Appurtenances; G

Submit manufacturer's standard drawings or catalog cuts.

SD-06 Test Reports

Pressure Test; G
Leakage Test; G

Reports for the following shall be submitted in accordance with paragraph entitled "Reports" of this section.

Reports; G

Test and inspection reports, as specified.

SD-07 Certificates

Certificates of compliance for the following items shall be submitted in accordance with the applicable reference standards and descriptions of this section.

PVC Plastic Sewer Piping; G
Ductile Iron Pipe; G

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualifications

Install specified materials by a licensed underground utility Contractor licensed for such work in the state 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. Installation drawings shall be submitted showing complete detail,

both plan and side view details with proper layout dimensions and elevations.

b. As-Built drawings for the complete sanitary sewer system shall be submitted showing complete detail with all dimensions, both above and below grade, including invert elevation.

c. As-Built drawings shall be signed and sealed by a Professional Surveyor. 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 Contracting Officer. 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.

2.1.1 PVC Plastic Sewer Piping

2.1.1.1 PVC Plastic Pipe and Fittings

Polyvinyl chloride (PVC) pipe and fittings shall conform to ASTM D 3034, Cell Classification 12454-B DR 35 with push-on joints and shall be green.

2.1.2 Ductile Iron Pipe

Ductile iron pipe shall be manufactured in accordance with AWWA C150/A21.50 and AWWA C151/A21.51 with push-on joints.

All non-flanged pipe shall be minimum Pressure Class 250.

Unless otherwise noted on the drawings, all ductile iron pipe exposed above grade shall be flanged ductile iron pipe in accordance with AWWA C115/A21.15, minimum thickness Class 53 with Class 125 flanges. Flanges shall be ductile iron.

All ductile iron pipe and ductile iron fittings shall be lined with protective 401 lining.

All buried pipe and fittings shall be petroleum asphalt coated according to the manufacturer's recommendations and encased in 8-mil high-density polyethylene tubes in accordance with AWWA C105/A21.5 Method A. All flanged and above grade or exposed pipe and fittings shall be painted in accordance with Section 09 90 00.00 98 PAINTING AND COATING. All above and below grade sewer piping shall be color-coded green.

Unless noted otherwise on the drawings, exposed fittings shall be flanged, ductile iron in accordance with AWWA C110/A21.10, rated for 250-psi operating pressure. Where new flanged pipe is to be joined with existing and other new flanges, adaptor flange pipe sections shall be provided if necessary.

All bolts, nuts, and studs shall be corrosion resistant alloy with hex heads or heavy hex heads conforming to AWWA C115/A21.15 and Appendix A of AWWA C115/A21.15, except where otherwise indicated on the drawings.

Flange gaskets shall conform to the requirements of AWWA C111/A21.11, shall be 1/8-inch thick full face-type and shall conform to the dimensions of Appendix A of AWWA C115/A21.15. Gaskets shall be suitable for the service conditions and shall be provided by the pipe manufacturer.

2.1.3 Pipeline Appurtenances

Provide fasteners in accordance with the following section unless otherwise noted.

1. General: For all exterior applications and where fastening aluminum, provide Type 304 stainless-steel fasteners. Provide hot-dipped galvanized fasteners in all other applications in accordance with ASTM A 153/A 153M unless noted otherwise on the drawings. Select fasteners for type, grade, and class required.

2. High-Strength Bolts and Nuts: ASTM A 325 with heavy hex nuts ASTM A 563 and hardened carbon-steel washers ASTM F 436.

3. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307,

Grade A, with hex nuts, ASTM A 563, and, where indicated, flat washers.

4. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group A4.

5. Stainless Steel Socket Button and Flat Countersunk Head Cap Screws: ASTM F 879.

6. Anchor Bolts: ASTM F 1554, Grade 36.

7. Eyebolts: ASTM A 489.

8. Machine Screws: ASME B18.6.3.

9. Lag Bolts: ASME B18.2.1.

10. Wood Screws: Flat head, ASME B18.6.1.

11. Plain Washers: Round, ASME B18.22.1.

12. Lock Washers: Helical, spring type, ASME B18.21.1.

13. Cast-in Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing conducted by a qualified independent testing agency according to ASTM E 488.

a. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized in accordance with ASTM A 153/A 153M.

14. Expansion Anchors: Anchor bolt and sleeve assembly with the ability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing conducted by a qualified independent testing agency according to ASTM E 488.

a. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

b. Material for Anchors in Exterior Locations: Alloy Group (A4) stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

2.1.4 Transition Couplings

Transition Coupling shall consist of a high-strength steel body, two steel or malleable iron flange or follower rings, a wedge shaped resilient gasket and sufficient number of follower bolts.

Adapter: Steel construction, ASTM A 513, ASTM A 635/A 635M or ASME SA-675GR60, free of surface defect.
Followers: AISI C1012 or ASME SA-36
Bolts: AWWA C111/A21.11
Gasket: Grade 27 BUNA-S.
Shop Paint: Fusion bonded epoxy coating.
Acceptable Manufacturers:

Dresser Manufacturing Division of Dresser Industries, Inc.; Dresser Styles 62 and 162 or approved equal.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Precast Concrete Manholes & Glass-Fiber-Reinforced Polyester Manholes

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C 478 and be manufactured in accordance with Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION; base and first riser shall be monolithic.

2.3 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."

3.1.1.1 Location

Where the location of the sewer is not clearly defined by dimensions on the drawings, the sewer main shall not be horizontally laid closer than 10 feet to a water main or service line. Install pressure sewer lines beneath water lines only, with the top of the sewer line being at least 2 feet below bottom of water line. Where sanitary sewer lines pass above water lines, encase sewer in concrete for a distance of 10 feet on each side of the crossing, or substitute rubber-gasketed pressure pipe for the pipe being used for the same distance. Where sanitary sewer lines pass below water lines, lay pipe so that no joint in the sewer line will be closer than 3 feet, horizontal distance, to the water line.

a. Sanitary sewer piping installation parallel with water line:

1 Normal conditions: Sanitary sewer piping or manholes shall be laid at least 10 feet horizontally from a water line whenever possible. The distance shall be measured edge-to-edge.

2 Unusual conditions: When local conditions prevent a horizontal separation of 10 feet, the sanitary sewer piping or manhole may be laid closer to a water line provided that:

(aa) The top (crown) of the sanitary sewer piping shall be at least 18 inches below the bottom (invert) of the water main.

(bb) Where this vertical separation cannot be obtained, the sanitary sewer piping shall be constructed of AWWA-approved ductile iron water pipe pressure tested in place without leakage prior to backfilling.

(cc) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of sanitary sewer piping crossing a water line:

1 Normal conditions: Lay sanitary sewer piping by crossing under water lines to provide a separation of at least 12 inches between the top of the sanitary sewer piping and the bottom of the water line whenever possible.

2 Unusual conditions: When local conditions prevent a vertical separation described above, use the following construction:

(aa) Sanitary sewer piping passing over or under water lines shall be constructed of AWWA-approved ductile iron water pipe, pressure tested in place without leakage prior to backfilling.

(bb) Sanitary sewer piping passing over water lines shall, in addition, be protected by providing:

(1). A vertical separation of at least 12 inches between the bottom of the sanitary sewer piping and the top of the water line.

(2). Adequate structural support for the sanitary sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.

(3). That the length, minimum 20 feet, of the sanitary sewer piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the water line.

c. Sanitary sewer manholes: No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.

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. Bottom of trench shall be shaped to give uniform circumferential support to the lower fourth of each pipe. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid true to line and grade in a manner to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the flow line. Interior of the sewer shall be cleared of superfluous materials at all times. Where cleaning after laying is difficult, a suitable swab or drag shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed. When the maximum width of the trench at the top of the pipe is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Government, such bedding as may be required to satisfactorily support the added load of the backfill. Trenches shall be kept free from water until the pipe-joining material has set. Pipe shall not be laid when the condition of the trench or the weather is unsuitable

for such work. When work is not in progress, open ends of pipe and fittings shall be closed to prevent intrusion of foreign materials.

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 PVC pipe shall conform to Table 4 of ASTM D 3034.

3.1.1.4 Connections to Existing Lines

Obtain approval from the Contracting Officer 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 HDPE Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with requirements of ASTM F 714.

3.1.2.2 Sewer Line Point Repairs

Defects may be located by evaluation procedures in other phases of this project at a certain distance from a reference manhole, which only affect one joint or section of pipe and are assumed to require a replacement of 10 feet or less of new pipe per repair. These repairs are classified as "point repairs."

Determining the exact location of any point repair is the responsibility of the Contractor. The Contracting Officer will provide existing or current video tapes and TV logs of the line sections scheduled for such repair and the Contractor shall examine the videotape and logs to determine if the original footage or repair is accurate. Any subsequent investigations made by the Contractor to accurately determine the location of the point repair shall be considered incidental to the work.

Care shall be exercised during initial excavation of the defective pipe or fittings to avoid disturbing the existing pipe and fittings to remain. The typical trench detail is shown on the drawings.

Sufficient barriers and other traffic control methods shall be in place around the excavation at all times. All flow control required for the work is the responsibility of the Contractor. Bypass pumping requirements are covered in Section 33 01 99 SLIPLINING (CIPP) OF EXISTING PIPING.

Carefully remove the defective pipe or fitting to prevent damage to the existing pipe, which will receive new connections. It is assumed that most repairs will involve two lengths of existing pipe sections since most defects are at joints or extend past joints. Removal of more than 10 feet of pipe will require approval of the Contracting Officer. All existing pipe cut will have smooth edges to accept the new connections. Minimum length of pipe replaced shall be 5 feet.

Prepare bedding as described in Section 31 00 00 EARTHWORK. The grade shall match existing.

Furnish and install new pipe or fittings as described. Make special note

of the proper joining of dissimilar materials if applicable. Use flexible couplers as shown in the typical details.

Sewer line point repair will encompass cracked pipe, broken pipe or service connection, faulty tap, protruding tap, sheared joint, dropped joint, manhole connection, or other similar conditions as determined by the Contracting Officer for "Point Repair." Furnish and install all necessary material to ensure proper sewer service after work is completed.

3.1.3 Miscellaneous Construction and Installation

3.1.3.1 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.

3.2 INSPECTION AND TESTING

3.2.1 General

Inspect all work constructed for faults or defects and correct any deviation from these documents or omissions at once. Conduct all tests and provide necessary equipment and personnel for lamping the system in the presence of the Contracting Officer. The Contractor shall bear all costs for these tests and inspections.

Test sewers by a low-pressure air test.

Ensure that pipe testing closely follows pipe laying. No more than 1,000 feet of pipe shall remain untested at any time.

3.2.2 Gravity Piping

Submit the proposed method of testing to the Contracting Officer for approval. Perform air testing in accordance with the procedures described in ASTM F 1417. Ensure that the equipment is specifically designed and manufactured for testing pipelines with low-pressure air and is provided with an air regulator valve or air safety valve set to prevent the air pressure in the pipeline from exceeding 8 psig. If the results of the air test are unsatisfactory, perform the exfiltration test as outlined above.

The following low-pressure air testing procedures may be used. Ensure that the sewer line has an orifice through which to pass air into the pipe. Connect an air supply to the orifice at one end of the line. The air supply line will contain an on/off gas valve and a pressure gauge with a range of 0 to 5 psi. Ensure that the gauge has minimum divisions of 0.10 psi and has an accuracy of plus/minus 0.04 psi. Properly block the seals at each manhole to prevent displacement while the line is under pressure. Pressurize the pipe line under test to 4 psig. Allow the line to stabilize between 4 psig and 3.5 psig for no less than 5 minutes. If necessary, add air to the line to maintain the pressure above 3.5 psig. After the stabilization period, close the gas valve. When the line pressure drops to 3.5 psig, begin timing with a stop watch. Allow the stop watch to run

until the line pressure drops to 2.5 psig. Then stop the watch and compare the time lapse to the allowable time lapse in these Specifications. If the time lapse is greater than that specified, the section undergoing the test shall have passed the low-pressure air test and the test will be discontinued at that time. If the time is less than that specified, the line has not passed the test (see Table 1 for test times).

TABLE 1 AIR TEST TABLE

Length (feet)	4	6	8	10	12	15	18	21	24
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30	--	--
175	0:31	1:09	2:03	3:13	4:37	5:05	--	--	--
200	0:35	1:19	2:21	3:40	5:17	--	--	--	12:06
225	0:40	1:29	2:38	4:08	5:40	--	--	10:25	13:36
250	0:44	1:39	2:56	4:35	--	--	8:31	11:35	15:07
275	0:48	1:49	3:14	4:43	--	--	9:21	12:44	16:38
300	0:53	1:59	3:31	--	--	--	10:12	13:53	18:09
350	1:02	2:19	3:47	--	--	8:16	11:54	16:12	21:10
400	1:10	2:38	--	--	6:03	9:27	13:36	18:31	24:12
450	1:19	2:50	--	--	6:48	10:38	15:19	20:50	27:13
500	1:28	--	--	5:14	7:34	11:49	17:01	23:09	30:14

3.2.3 Infiltration

After the work is complete, test the sewers or sections for infiltration. Any section in which the infiltration of water is detected will be rejected until corrective work has been performed. No infiltration will be allowed for any one trunk, main, lateral, or segment between manholes.

3.2.4 Exfiltration

The Contracting Officer may require tests for exfiltration. Ensure that exfiltration is in accordance with the requirements of ASTM requirements as modified by the Contracting Officer. Permit an allowance of 10 percent of exfiltration gallonage for each additional 10-foot head over the basic

top-of-manhole head.

3.2.5 Television Inspection

Inspect all new sewer mains by internal television inspection, providing accurate distances to all service, with logs and video record of inspection. Provide all equipment and labor for such inspection. Any subcontractor must be approved by the Government before work. Acceptable procedures for televising and video recording are available from the Contracting Officer. Take digital video records of all inspection, including the manholes. Prepare the DVD and, after review by the Contracting Officer, deliver it to the Government. The Contracting Officer or Government's representative shall observe the television inspection.

3.2.6 Alignment and Deflection

Ensure that lines show full circle of light when lamped between manholes for line sections with complete pipe replacement.

Pass a nine-point mandrel through each new flexible pipe section installed after full backfill has been placed. Ensure that the maximum pipe diameter deflection does not exceed 5 percent.

3.2.7 Repair of PVC Piping

At the option of the Contracting Officer, if PVC piping is found to be defective during the warranty test period and if the Contracting Officer does not approve a method of pipe repair by the Contractor, the Contractor shall remove and replace the faulty pipe in an approved manner at no additional cost to the Government.

3.2.8 Tests of Ductile Iron Pressure Lines

3.2.8.1 Pressure Test

Pressure test shall be made no sooner than 72 hours after installation of thrust blocks.

After the pipe is laid, the joints completed, and the trench backfilled, the newly laid piping or any valved section of piping shall be subjected for 1 hour to a hydrostatic-pressure test of 150 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, and valves shall be carefully examined during the open-trench test. Joints showing visible leakage shall be replaced or remade as necessary. Leaking rubber gasketed joints shall be remade using new gaskets when necessary. Pipe, mechanical joints, fittings, or valves discovered to be cracked or defective as a consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are approved.

3.2.8.2 Leakage Test

Leakage tests shall be conducted concurrently with the pressure test. The duration of each leakage test shall be at least 2 hours. During the test, the main shall be subjected to a pressure of 150 psi. Leakage is defined as the additional quantity of water supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage volume is defined by the formula:

$$L = \frac{SD(P)^{1/2}}{C}$$

in which:

L = allowable leakage (gallons)
S = length of pipe tested (feet)
D = diameter of the pipe (inches)
P = specified test pressure (psig)
C = 133,200

Allowable leakage in gallons per hour per 1,000 feet of pipeline shall be as follows:

PIPE DIAMETER (INCHES)	ALLOWABLE LEAKAGE (GALLONS PER HOUR)
4	0.37
6	0.55
8	0.74
10	0.92
12	1.10
14	1.29
16	1.47

Allowable leakage in gallons per hour not exceed 5 percent of total system pressure.

Should any test of laid pipe disclose a leakage greater than that shown, the defective joints shall be located and repaired until the leakage is within the specified tolerance, at no additional cost to the Government.

3.2.8.3 Test Timing

Except where concrete-reaction backing necessitates a 72-hour delay, pipelines jointed with rubber gaskets, mechanical, or bolted joints may be subjected to hydrostatic pressure, inspected, and tested for leakage after partial completion of backfill.

3.2.8.4 Retesting

Before permanent paving is placed over the pipeline, a measured leakage test of the entire pipeline shall be required. Leakage loss shall be within approved tolerances.

3.3 CLEANING

Thoroughly clean all precast structures of all silt, debris, and foreign matter of any kind before final inspections.

3.4 ACCEPTANCE

Sections of the sewer and manholes found defective in material, alignment, grade, or joints shall be corrected at no additional cost to the Government before acceptance.

-- End of Section --

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SEWAGE LIFT STATIONS

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.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C111/A21.11	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C207	(2007) Standard for Steel Pipe Flanges for Waterworks Service-Sizes 100 mm through 3600 mm 4 in. through 144 in.
AWWA C504	(2006) Standard for Rubber-Seated Butterfly Valves
AWWA C550	(2005; Errata 2005) Protective Epoxy Interior Coatings for Valves and Hydrants

ASME INTERNATIONAL (ASME)

ASME B16.1	(2005) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B31.3	(2008) Process Piping

ASTM INTERNATIONAL (ASTM)

ASTM A 126	(2004) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 48/A 48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A 536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM A 743/A 743M	(2006) Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM B 584	(2009) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM C 443	(2005a) Standard Specification for Joints

for Concrete Pipe and Manholes, Using Rubber Gaskets

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1940-1 (2003; Corrigendum 2005) Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerance - International Restrictions

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-70 (2006) Standard for Cast Iron Gate Valves, Flanged and Threaded Ends

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixtures List in accordance with paragraph entitled, "General Requirements," of this section.

Listing of Product Installations

SD-02 Shop Drawings

Submit the following in accordance with paragraph entitled, "Design Requirements," of this section.

Fabrication Drawings; G
Erection/Installation Drawings; G
Bypass Pumping Plan; G

SD-03 Product Data

Submit Spare Parts Data also for the following in accordance with paragraph entitled, "General Requirements," of this section.

Submit manufacturer's catalog data and equipment and performance data for the following items:

Package Lift Station; G
Access Covers; G
Sewage Pumps; G
Pump Controls; G
Impellers; G
Nameplate; G
Couplings; G
Stuffing Boxes; G
Valves; G
Quick Disconnect; G

Piping; G
Valve Vault; G
Electric Motors; G
Lift Station Controls; G

Submit paint and manufacturer's recommendations for painting including material storage, mixing, and thinning surface preparation, number and thickness of coats, application drying between coats and final etc. shall be submitted.

Submit the following in accordance with paragraph entitled, "General," of this section:

Preventative Maintenance and Inspection
Posted Instructions

SD-05 Design Data

Safety Considerations

1.3 QUALITY ASSURANCE

1.3.1 Drawings

a. Erection/installation drawings shall be submitted showing complete detail, both plan and side view details with proper layout dimensions and elevations.

b. As-built drawings for the complete sanitary sewer system shall be submitted showing complete detail with all dimensions, both above and below grade, including invert elevation.

c. As-built drawings shall be signed and sealed by a Professional Surveyor. Include the following statement: "All potable water lines crossed by sanitary hazard mains are in accordance with the permitted utility separation requirements."

1.4 DESIGN REQUIREMENTS

The lift stations shall have two submersible centrifugal pumps as specified herein with pump controls capable of operating the pumps either simultaneously or individually, depending on the load conditions.

Fabrication drawings shall be submitted after receiving tentative approval of the equipment and the materials list but before installation. The Contractor shall submit drawings covering necessary or recommended changes to accommodate the equipment offered. Drawings shall clearly show the wet well, with dimensions and elevation levels with reference to those elevations indicated.

Submit a sanitary sewer bypass pumping plan in accordance with the drawings that show the temporary bypass pumping plan of the wastewater during renovation/demolition/replacement of the manhole preceding the lift station. The plan shall include pump size and capacity; the methodology of capping influent pipes; a diagram of pumping system, pipe routing, and temporary point of connection to existing lift station.

1.5 PROTECTION FROM MOVING PARTS

Locate guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts in accordance with applicable OSHA standards and so that personnel are properly protected from injury.

1.6 NAMEPLATES

Provide the manufacturer's name or trademark on a corrosion-resistant identification plate or cast integrally, on each item of equipment, stamped, or otherwise permanently marked in a conspicuous place. Include on the pump identification plate the pump capacity in gpm, pump head in feet and speed of rotation. Cast on the body of the pump the direction of rotation. Indicate all necessary information to complete identification such as the manufacturer.

1.7 FIELD REPRESENTATIVE

A representative of the lift station pump manufacturer hired by the Contractor shall inspect the pump installation and direct the startup of the station and shall instruct representatives of the Government in startup and operating procedures. The Contractor shall procure the services of the lift station pump manufacturer representative for the following:

1. A minimum of 1 full day on site to inspect, adjust, and test the lift station installation and provide certification as specified.

2. A minimum of 1 full day on site to place the station in operation to demonstrate compliance with the requirements of the Contract Documents.

3. A minimum of 1 full day onsite to train representatives of the Government in the operation, maintenance, and repair of station pumps, control panel, and related appurtenances.

The manufacturer's services specified represent an absolute minimum acceptable level of service, and are not intended to limit the responsibilities of the Contractor to comply with all requirements of the Contract Documents. At no additional cost to the Government, the Contractor shall procure all services required, including additional cost to the Government to the jobsite by the manufacturer's representative to comply with these requirements.

The Contractor shall submit written certification from the lift station pump manufacturer's representative that he has inspected, adjusted, tested, etc., the lift station installation and that all aspects of the installation meet requirements of the pump manufacturer for satisfactory performance and working life of the equipment. The written certification shall state that the system is installed and operating properly and is ready for acceptance by the Government.

1.8 GENERAL REQUIREMENTS

Submit Material, Equipment, and Fixtures List of all major components including manufacturer's catalog numbers, specification and drawing reference number, warranty information, and fabrication site.

Submit Listing of Product Installations similar to the package lift station the Contractor is installing.

Submit Safety Considerations including information relating to load limits, speed of operation, environmental criteria (temperature and pressure limitations), and personnel hazards and equipment safety precautions for the package lift station.

Submit Spare Parts Data, including a complete list of parts and supplies with current unit prices and source of supply. List parts and supplies that are either normally furnished at no extra cost with the purchase of equipment, or specified to be furnished as a part of the contract, and list additional items recommended by the manufacturer to ensure an efficient operation for a period of one year.

PART 2 PRODUCTS

Verify conformance of materials and equipment for package lift station to the referenced publications or as specified. Verify manufacturers are regularly engaged in the manufacture of such products.

Submit manufacturer's data indicating percentage of recycled material content in packaged sewage lift stations to verify affirmative procurement compliance.

2.1 PRECAST WET WELLS AND VALVE VAULTS -- LIFT STATION 4B AND LIFT STATION 9A

The precast wet wells and valve vaults shall be sized as shown on the drawings and shall conform to the requirements of Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION.

The precast wet wells shall be lined with the protective liner specified in Section 09 93 00 CONCRETE REPAIR AND HYDROGEN SULFIDE PROTECTIVE COATING at the precast factory.

2.2 ACCESS COVERS

The access covers for wet wells shall be aluminum plate designed for 300 pounds per square foot live load. The covers shall be securely bolted to each concrete structure with stainless steel hinges and hardware. Covers shall have a diamond pattern non-skid surface and stainless steel recessed handles. Covers shall meet the requirements of Section 05 50 13 MISCELLANEOUS FABRICATIONS.

2.3 SEWAGE PUMPS

2.3.1 End-Suction Pumps

Provide submersible sewage end-suction pumps as manufactured by Cornell or approved equal. The pump volute, motor, and seal housing shall be high-quality gray cast iron in accordance with ASTM A 48/A 48M, Class 30. All fasteners exposed to the pumped liquids shall be 316 stainless steel.

2.3.1.1 Pump and Motor Characteristics

2.3.1.1.1 Lift Station 1AA

Liquid Pumped:	Raw Sewage
Pumping Temperature:	Ambient Temperature
Number of Units Required:	2

Model:	4414-VC18DB
Design Point:	770 gpm @ 203 ft TDH
Shutoff Head:	246 ft
Discharge Size:	4 inch
Motors:	1,760 rpm/Oil Cooled Induction/Insulation Class F/75 horsepower/460v/3-phase/60 hz Service Factor 1.2 NEMA design, Type B.

2.3.1.1.2 Lift Station 4A

Liquid Pumped:	Raw Sewage
Pumping Temperature:	Ambient Temperature
Number of Units Required:	2
Model:	4414-VC18DB
Design Point:	450 gpm @ 197 ft TDH
Shutoff Head:	229 ft
Discharge Size:	4 inch
Motors:	1,760 rpm/Oil Cooled Induction/Insulation Class F/75 horsepower/460v/3-phase/60 hz Service Factor 1.2 NEMA design, Type B.

2.3.2 Centrifugal Pumps

Provide submersible sewage centrifugal pumps as manufactured by Hydromatic Pumps, Cornell, or approved equal. The pump volute, motor, and seal housing shall be high-quality gray cast iron in accordance with ASTM A 48/A 48M, Class 30. All fasteners exposed to the pumped liquids shall be 316 stainless steel.

2.3.2.1 Pump and Motor Characteristics

2.3.2.1.1 Lift Station 4B

Liquid Pumped:	Raw Sewage
Pumping Temperature:	Ambient Temperature
Number of Units Required:	2
Model:	H4HX1000
Design Point:	230 gpm @ 63 ft TDH
Shutoff Head:	898 ft
Discharge Size:	4 inch
Motors:	1,750 rpm/Oil Cooled Induction/Insulation Class H/10 horsepower/480v/3-phase/60 hz Service Factor 1.2 NEMA design, Type B.

2.3.2.1.2 Lift Station 4N1

Liquid Pumped:	Raw Sewage
Pumping Temperature:	Ambient Temperature
Number of Units Required:	2
Model:	H4HX1500
Design Point:	220 gpm @ 71 ft TDH
Shutoff Head:	97.5 ft
Discharge Size:	4 inch
Motors:	1,750 rpm/Oil Cooled Induction/Insulation Class F/15 horsepower/460v/3-phase/60 hz Service

Factor 1.2 NEMA design, Type B.

2.3.2.1.3 Lift Station 4S

Liquid Pumped:	Raw Sewage
Pumping Temperature:	Ambient Temperature
Number of Units Required:	2
Model:	HPGFX-750
Design Point:	148 gpm @ 75 ft TDH
Shutoff Head:	97.5 ft
Discharge Size:	4 inch
Motors:	1,750 rpm/Oil Cooled Induction/Insulation Class F/15 horsepower/480v/3-phase/60 hz Service Factor 1.2 NEMA design, Type B.

2.3.2.1.4 Lift Station 9A

Liquid Pumped:	Raw Sewage
Pumping Temperature:	Ambient Temperature
Number of Units Required:	2
Model:	4NHDH-SUB-50-4
Primary Design Point:	153 gpm @ 152 ft TDH
Secondary Design Point:	194 gpm @ 149 ft TDH
Shutoff Head:	164 ft
Discharge Size:	4 inch
Motors:	1,770 rpm/Oil Cooled Induction/Insulation Class F/50 horsepower/480v/3-phase/60 hz Service Factor 1.2 NEMA design, Type B.

2.3.2.1.5 Lift Station 10A

Liquid Pumped:	Raw Sewage
Pumping Temperature:	Ambient Temperature
Number of Units Required:	2
Model:	H4HX1500
Design Point:	190 gpm @ 80- ft TDH
Shutoff Head:	106 ft
Discharge Size:	4 inch
Motors:	1,750 rpm/Oil Cooled Induction/Insulation Class F/15 horsepower/480v/3-phase/60 hz Service Factor 1.2 NEMA design, Type B.

2.3.2.1.6 Lift Station 12A

Liquid Pumped:	Raw Sewage
Pumping Temperature:	Ambient Temperature
Number of Units Required:	2
Model:	S3HVX-300
Design Point:	60 gpm @ 30 ft TDH
Shutoff Head:	44.9 ft
Discharge Size:	3 inch
Motors:	3,450 rpm/Oil Cooled Induction/Insulation Class F/3 horsepower/208v/3-phase/60 hz Service Factor 1.2 NEMA design, Type B.

2.3.3 Grinder Pumps

Provide submersible sewage grinder pumps as manufactured by Hydromatic Pumps or approved equal. The pump volute, motor, and seal housing shall be high-quality gray cast iron in accordance with ASTM A 48/A 48M, Class 30. All fasteners exposed to the pumped liquids shall be 316 stainless steel.

2.3.3.1 Pump and Motor Characteristics

2.3.3.1.1 Lift Station 1L

Liquid Pumped:	Raw Sewage
Pumping Temperature:	Ambient Temperature
Number of Units Required:	2
Model:	HPGFX-300
Design Point:	66 gpm @ 39 ft TDH
Shutoff Head:	51.1 ft
Discharge Size:	4 inch
Motors:	1,750 rpm/Oil Cooled Induction/Insulation Class F/3 horsepower/460v/3-phase/60 hz Service Factor 1.2 NEMA design, Type B.

2.4 PUMP CONSTRUCTION

Fabricate castings from cast iron or steel free from injurious defects. Design castings to permit easy replacement of parts. Gasket all joints to prevent leakage under a test pressure equal to 50 percent more than the pump discharge pressure or total dynamic head, whichever is greater. Design and install passageways to permit the smooth flow of sewage and free from sharp turns and projections. Provide pump castings with cleanout plates in the suction line and drain plugs.

2.5 IMPELLERS

For end-suction pumps, impeller shall be non-metallic, semi-open Valox molded to bronze insert. For grinder pumps, impeller shall be red brass ASTM B 584-836. For centrifugal pumps, impeller shall be cast iron. Pump out vanes shall preclude material buildup around the shaft and seal.

Impellers shall be dynamically balanced. The tolerance values shall be according to the International Standard Organization grade 6.3 for rotors in rigid frames. The tolerance is to be split equally between the two balance planes, which are the two impeller shrouds.

2.6 COUPLINGS

For end-suction pumps, provide heavy-duty flexible type couplings, keyed to the shaft. Provide universal type couplings for vertical pumps.

2.7 SHAFT SLEEVES

For end-suction pumps, protect the shaft from the liquid being pumped, points in contact with the stuffing boxes, and other wearing parts with sleeves designed in bronze or a suitable alloy.

2.8 STUFFING BOXES

For end-suction pumps, grease-seal stuffing boxes with a seal ring,

designed to ensure tight packing without excessive wear or friction on the shafts, and prevent the leakage of air or water. Provide split type glands which can be easily removed for repacking.

2.9 BALANCE

Balance rotating parts of the equipment mechanically and hydraulically to operate throughout the required range without excessive end thrust, vibration, and noise. Conform allowable vibration limits with ISO 1940-1, Table 1. Existence of defects that cannot be eliminated by adjustment will be sufficient cause for rejection of the equipment.

2.10 SHAFTS

For centrifugal and grinder pumps, provide high-grade 3300 series stainless steel shafts of a size and strength to perform the work required.

2.11 BEARINGS AND SHAFTS

An upper radial bearing and a lower thrust bearing shall be required. These shall be heavy-duty single-row ball bearings that are permanently lubricated by the dielectric oil that fills the motor housing. Double-row, sealed-grease packed bearings shall not be acceptable. Bearings which require lubrication according to a prescribed schedule shall not be acceptable. The upper radial housing shall have a minimum B-10 life at the specified condition of 40,000 hours and the lower thrust bearing shall have a minimum B-10 life at the specified condition of 40,000 hours.

The shaft shall be machined from a solid 300 series stainless steel forging and shall be designed with a large diameter, having a minimum overhang to reduce shaft deflection and prolong bearing life.

2.12 LUBRICATION

Provide self lubricating, permanently lubed bearings.

2.13 SEALS

The pump shall have two mechanical seals, mounted in tandem, with an oil chamber between the seals. Units that required the use of tungsten-carbide seals or foreign manufactured seals shall not be acceptable.

The pump shall be equipped with a seal leak detection probe and warning system. This shall be designed to alert maintenance personnel of lower seal failure without having to take the unit out of service for inspection or requiring access for checking the seal chamber oil level and consistency.

Install an electric probe or seal failure sensor in the seal chamber between the two tandem mechanical seals. If the lower seal fails, contaminants which enter the seal chamber shall be detected by the sensor and sent a signal to operate the specified warning device.

Units equipped with opposed mechanical seals shall not be acceptable.

2.14 PIPING CONNECTIONS

Provide pump discharge with flanged connections of the proper size for the pump type and capacity. Conform pipe flanges to ASTM A 536 for ductile iron or gray-iron threaded flanges and piping or AWWA C207. Piping is to

conform to the requirements of ASME B31.3.

2.15 VALVES

2.15.1 Check Valve

1. Check valves shall be swing-check type with outside lever and weight and shall permit free flow of sewage forward and provide a positive check against backflow. Check valves shall be designed for a minimum working pressure of 150 psi. The manufacturer's name, initials, or trademark and also the size of the valve, working pressure, and direction of flow shall be directly cast on the body.

2. Swing check valves shall exceed the minimum requirements of AWWA C508 with a heavy-duty body of cast iron conforming to ASTM A 126 Class B with integral flanges, faced and drilled in accordance with ASME B16.1 Class 125. Bolts, nuts, washers, etc., shall be 316 stainless steel.

3. The valve body shall be the full waterway type, designed to provide a net flow, not less than the nominal inlet pipe size, when swung open no more than 25 degrees. The valve shall have a replaceable stainless steel body seat, a cast iron disc faced with a renewable resilient seat ring of rubber, and shall be held in place by stainless steel screws.

4. The disk arm shall be ductile iron or steel, suspended from and keyed to a stainless steel shaft, which is completely above the waterway and supported at each end by heavy bronze bushings. The shaft shall rotate freely without the need for external lubrication. Where it passes through the body, the shaft shall be sealed by means of a stuffing box and adjustable packing. Simple O-ring shaft seals are not acceptable.

5. The check valve shall be GA Industries, Inc. Figure 220-DS or an approved equal.

6. The valve interior shall be painted with epoxy coating by the valve manufacturer in accordance with AWWA C550. The valve exteriors shall be factory prepared and primed, and field finish painted in accordance with Section 09 90 00.00 98 PAINTING AND COATING.

2.15.2 Plug Valve

1. Confirm plug valves to MSS SP-70.

2. Plug valves shall be of the non-lubricated eccentric type with resilient-faced plugs and shall be furnished with end connections as shown on the drawings. Flanged valves shall be faced and drilled to the ANSI 125-lb standard. Mechanical joint ends shall be to AWWA C111/A21.11. Screwed ends shall meet the NPT standard.

3. Valve bodies shall be made of ASTM A 126 Class B cast iron. Bodies in 4-inch valves shall be furnished with a 1/8-inch welded overlay seat of not less than 90 percent pure nickel. The seat area shall be raised, with raised surface completely covered with weld to ensure that the plug face contacts only nickel. Screwed-in seats shall not be acceptable.

4. Plugs shall be of ASTM A 126 Class B cast iron. The plug shall have a cylindrical seating surface, eccentrically offset from the center of the plug shaft. With the plug in the closed position, the interference between the plug face and body seat shall be externally adjustable in the field

with the valve in the line under pressure. The plug shall be resilient faced with hycar, formulated and constructed to be suitable for use with sewage.

5. Valves shall have sleeve-type metal bearings and shall be of sintered, oil-impregnated, permanently lubricated Type 316 ASTM A 743/A 743M Grade CF-8M in 4-inch sizes. Nonmetallic bearings shall not be acceptable.

6. Valve shaft seals shall be of the multiple V-ring type and shall be externally adjustable and repackable without removing the bonnet or actuator from the valve under pressure. Valves using O-ring seals or non-adjustable packing shall not be acceptable. All exposed nuts, bolts, springs, washers, and other fasteners shall be 300-series stainless steel.

7. The valve working pressure ratings shall be at least 175 psi. Each valve shall be given a hydrostatic and seat test with certified copies of proof-of-design test reports furnished as outlined in AWWA C504, Section 5.5.

8. Unless noted otherwise, valves shall be equipped with the following actuators:

a. Exposed valves 4 inches: removable lever actuators.

9. Geared actuators shall be worm-gear type. Geared actuators and mounting brackets shall be designed for buried and submerged service and shall be totally enclosed in a semi-steel housing and equipped with all necessary seals and gaskets to prevent entry of water.

10. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque.

11. All exposed nuts, bolts, and washers shall be 300-series stainless steel.

12. All actuators shall be furnished by the valve manufacturer and shall be factory assembled, adjusted, and tested with the valve. Tests reports shall be available upon request.

13. The exterior of valves and actuators shall be factory prepared and primed, and field finish coated in accordance with Section 09 90 00.00 98 PAINTING AND COATING. Buried valves shall be polyethylene encased as specified herein for ductile iron pipe and fittings.

14. Plug valves shall be FIG 119 as manufactured by DeZurik or approved equal.

2.16 QUICK DISCONNECT

Quick disconnect shall be rated for a minimum pressure rating of 150 psi and shall be constructed of 316 stainless steel. The quick disconnect outlet shall be male American Standard Taper Pipe Thread. Size shall be as indicated on the drawings. The quick disconnect shall be product number 633-F by OPW or approved equal.

2.17 DUST CAP

The dust cap shall be compatible with the quick disconnect and shall be constructed of 316 stainless steel. The dust cap shall be product number

634-B by OPW or approved equal.

2.18 PIPING

Terminate discharge lines 5-feet outside the lift station in flanged connections. Include the pipe from the wet well manhole in the suction line. External connection joints for pipe using rubber gaskets are to comply with the standards of ASTM C 443.

Piping shall be in accordance with Section 33 30 00 SANITARY SEWERS, except that non-potable piping shall have protective 401 coating or approved equal.

2.19 ELECTRICAL POWER CORD

Electrical power cord shall be water resistant 600 V, 140 degree F, UL and CSA approved and applied depending on amp draw for size.

The pump shall be triple protected with a compression fitting and two epoxy-potted areas at the power cord entry to the pump. A separation between the junction box area of the pump and motor by a stator lead sealing gland or terminal board shall not be acceptable.

The power cable entry into the cord cap assembly shall first be made with a compression fitting. Each individual lead shall be stripped down to bare wire at staggered intervals, and each strand shall be individually separated. This area of the cord cap shall then be fitted with an epoxy compound potting that will prevent water contamination from gaining entry if wicking or capillary attraction occurs.

The power cord leads shall then be connected to the motor leads with extra heavy connectors having brass inserts with a screwed wire-to-wire connection.

The connection box wiring shall be separated from the motor housing wiring by stripping each lead down to bare wire, at staggered intervals and separating each strand. This area shall be filled with an epoxy compound potting. Fiberglass terminal boards that are subject to heat fatigue and cracking, and which may lead to possible leaks, shall not be acceptable.

The cord cap assembly where bolted to the connection box assembly shall be sealed with a Buna N Rubber O-ring on a beveled edged to ensure proper sealing.

2.20 ELECTRIC MOTORS

The stator, rotor, and bearings shall be mounted in a sealed submersible type housing. The stator windings shall have Class F insulation, and a dielectric oil-filled motor, NEMA B design.

The pump and motor shall be specifically designed so that they may be operated partially or completely submerged in the liquid being pumped.

Stators shall be securely held in place with a removable end ring and threaded fasteners so they may be easily removed in the field and must be capable of being repaired or rewound by a local motor service station. No special tools shall be required for pump and motor disassembly.

The pump motor shall be equipped with heat sensors. The heat sensors shall be a low-resistance, bi-metal disc that is temperature sensitive. They

shall be mounted directly in the stator, sized to open at 250 degrees F, and automatically reset at 90 to 95 degrees F differential. The sensor shall be connected in series with the motor starter coil so that the starter is tripped if a heat sensor opens. The motor starter shall be equipped with overload heaters so all normal overloads are protected by an external heater block.

Each pump motor shall have a sensor to monitor moisture in the stator cavity. Provide a conductivity-sensitive relay for installation in the control panel to alarm excessive moisture content, which may be indicative of an outer mechanical seal FAILURE.

2.20.1 Lift Station Controls

All instrumentation, control, and electrical components provided under this section shall be of an industrial quality equal to the components specified in Division 26, ELECTRICAL, and Section 40 95 00 PROCESS CONTROL SYSTEM, except as noted otherwise.

The instrumentation and controls system, specified herein, shall accept single-phase, 120V, 60-Hz AC electrical power, except were noted herein.

2.20.1.1 Scope

This paragraph (2.20.1 Lift Station Controls) pertains to all the lift stations, with the exception of Lift Station 10A. The specification for Lift Station 10A control system is presented in Section 40 95 00 PROCESS CONTROL SYSTEM.

2.20.1.2 Enclosure(s)

Control Panel - 304 SST, NEMA 4X rated, 3-point latch, complete with swing-out, dead-front panel. Provide a solar-shield for each panel as illustrated in the drawings.

2.20.1.3 Operator Interface

Provide the following interface devices:

a. Lift Station Pumps (one complete set for each pump).

1. HAND/OFF/AUTO selector switch.
2. 'RUN' status pilot light.
3. Elapsed time meter.

b. Alarm Annunciation.

1. Alarm horn 'SILENCE' pushbutton.
2. Alarm 'RESET' pushbutton.
3. Pump No. 2 'Seal Leak'.
4. Pump No. 1 'Motor Temp HIGH'.
5. Pump No. 2 'Seal Leak'.
6. Pump No. 2 'Motor Temp HIGH'.

Mount all controls and indicators on the swing-out, dead-front panel. Do not mount any device on the enclosure door.

Mount the alarm beacon and horn on control panel enclosure as indicated on the drawings.

2.20.1.4 External Interfaces

Provide the following signal interface(s) each of which terminated at the terminal strip, clearly designated as external signal interface:

a. Discrete outputs:

1. Control Power ON
2. Pump No. 1 RUN Status
3. Pump No. 2 RUN Status
4. Common Pump FAIL
5. Wet Well Level HIGH

b. Discrete inputs:

The following signals interface with components located in a classified environment (see electrical drawings). Provide suitable safety barrier(s) as needed to comply with NEC.

1. Wet Well Level HIGH HIGH Alarm
2. Wet Well Level START LAG
3. Wet Well Level START LEAD
4. Wet Well Level STOP ALL
5. Wet Well Level LOW LOW Alarm
6. Pump No. 1 Seal Failure
7. Pump No. 1 Motor Temperature HIGH
8. Pump No. 2 Seal Failure
9. Pump No. 3 Motor Temperature HIGH

2.20.1.5 Functional Requirements

a. Provide electro-mechanical (i.e. hard-wired, relay-based logic, using electro-mechanical relays and solid-state logic circuits) controls. The operating functions shall be as specified under 'General Lift Station Sequence of Operation' provided in the drawings, and as provided below.

b. Indicate the ALARM condition, both visually and audibly whenever wet well level exceeds the HIGH HIGH level setpoint. Provide silence function for the audible alarm.

c. Maintain all ALARM conditions until the offending condition is removed and the alarm is manually RESET.

2.20.1.6 Special Requirements

a. Provide and install a control power transformer to convert the 480-VAC, 60-Hz power feed provided to the control panel to 120-VAC, single-phase control voltage. Provide for one power feed to the control panel only.

b. Provide and install a Main Circuit Breaker (MCB) and Generator Circuit Breaker (GCB); the MCB for the power utility 480 VAC, 60 Hz power feed, the GCB for the generator 480 VAC, 60 Hz power feed. Inter-lock the two breakers to avoid having both simultaneously closed. Allow operation of the breaker with the swing-out, dead-front panel closed. Interlock the swing-out panel with the operation MCB/GCB to prohibit opening of the swing-out panel while the MCB/GCB is energized. Provide the generator receptacle as indicated on the drawings.

c. Provide and install motor feed with non-reversing, motor starters for each pump. Allow for operation of the motor feeder circuit breakers with the swing-out, dead-front panel closed. Starters shall be as specified in Section 26 05 71.00 40, and as shown on the drawings. Starters shall be equipped with Solid State Overload (SSOL) relays as specified in Section 26 05 71.00 40.

d. Provide and install non-mercury float switches as noted on the drawings, complete with intrinsically safe relays. Float switches shall be of the suspended type with polypropylene or PVC body. Units shall have an integral electrical cable with two #19 AWG stranded conductors. Switches shall be pilot duty, normally open or normally closed, as required for application.

e. Provide and install elapsed time meters for each motor. The meters shall be non-resettable, having six-digit indication of run time, and resolution of 0.1 hours. Run the meters whenever the pump motor starter is energized.

f. Provide and install a phase-loss/unbalance/reversal and under-voltage protection assembly with adjustable nominal voltage setting. Configure the pump logic to automatically lockout pump operation if all phases drop below 90 percent or of one phase drops below 80-83 percent nominal voltage. The device dropout delay shall be 1/2 second, nominally. The phase failure relay shall be Diversified Electronics.

g. Provide an alarm horn. Mount the alarm horn on the side of the panel.

h. Provide an alarm beacon. Mount the alarm beacon on the top of the panel.

i. Provide and install one (1) convenience receptacle.

2.21 PAINT

Surfaces to be painted include the wet well interior and all piping, conduit, etc., within the wet wells, and aluminum surfaces in contact with concrete.

Provide painting and coatings requirements in accordance with 09 90 00.00 98 PAINTING AND COATING and 09 93 00 CONCRETE REPAIR AND HYDROGEN SULFIDE PROTECTIVE COATING.

2.22 GUIDE RAIL ASSEMBLY

If applicable, guide rails shall be mounted to the basin floor on stainless steel riser supports. Guide rails shall be 300 Series stainless steel and size shall be in accordance with the pump manufacturer's recommendation. Each pump shall be equipped with a stainless steel upper and lower guide assembly, stainless steel lifting bail, and stainless steel lifting cable.

2.23 Heavy Duty Safety Switch

Provide a non-fused, NEMA 3R, stainless steel, heavy duty safety switch at each lift station. Mount the safety switch either on the back side of the control panel rack or adjacent to the control panel on the front side of the rack. Connect the safety switch on the line side of the control panel feeder circuit so that the control panel can be deenergized locally for

maintenance activities. Size the safety switches to supply the system voltage full ampacity of the supply circuit.

PART 3 EXECUTION

3.1 GENERAL

Install lift station as indicated, in accordance with drawings and the manufacturer's instructions.

Submit Preventative Maintenance and Inspection procedure for package lift stations sewage pumps. Include in procedures the frequency of preventative maintenance, inspection, adjustment, lubrication, and cleaning necessary to minimize corrective maintenance and repair.

Submit a complete package of Posted Instructions, consisting of labels, signs, and templates of operating instructions that are required to be mounted or installed on or near the package lift stations and pumps.

3.2 PIPING

3.2.1 Flanged and Threaded Joints

3.2.1.1 Flanged Joints

Flanged joints shall be faced true, provided with gaskets, and made perfectly square and tight. Flanged joints shall be used in special cases where connected equipment is available with only flanged joints, or when specifically shown on the drawings.

3.2.1.2 Threaded Joints

Threaded joints shall have graphite or inert filler and oil, graphite compound, or polytetrafluoroethylene (PTFE) tape applied to the male threads only. Unions shall be provided at all screwed valves, strainers and connections to equipment 3/4 inch and smaller. Dielectric unions shall be used at connections of dissimilar metals in 3/4 inch and smaller piping.

3.2.2 Pipe Supports in Valve Vaults

Horizontal and vertical runs of pipe in valve vaults shall be securely supported.

3.3 VALVE VAULTS AND ACCESSORIES

3.3.1 Piping and Equipment in Valve Vaults

Piping and equipment in valve vaults shall be installed to provide easy access without stepping on piping or equipment, and to provide sufficient working room. Piping and equipment in valve vaults shall be installed and supported as shown on the drawings. All plug and check valves shall be installed with the stems horizontal or above.

3.4 TESTS

Commercial testing shall be required and include the following:

The pump shall be visually inspected to confirm that it is built in

accordance with the specification as to HP, voltage, phase, and hertz.

The motor and seal housing chambers shall be hi-potted to test for moisture content and/or insulation defects.

Pump shall be allowed to run dry to check for proper rotation.

Discharge piping shall be attached, the pump submerged in water and amp readings shall be taken in each leg to check for an imbalanced stator winding. If there is a significant difference in readings, the stator windings shall be checked with a bridge to determine if an unbalanced resistance exists. If so, the stator will be replaced.

Perform a pump down test to verify that pumps are operating as expected.

For testing of the wetwell refer to Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION.

3.5 OPERATION AND MAINTENANCE

Refer to Section 01 78 23 OPERATION AND MAINTENANCE DATA.

3.6 FORMS

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER _____ EQPT SERIAL NO: _____

EQPT TAG NO: _____ EQPT/SYSTEM: _____

PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

_____ Installed in accordance with Manufacturer's recommendations.

_____ Inspected, checked, and adjusted.

_____ Serviced with proper initial lubricants.

_____ Electrical and mechanical connection meet quality and safety standards.

_____ All applicable safety equipment has been properly installed.

_____ System has been performance tested, and meets or exceeds specified performance requirements (when complete system of one manufacturer).

Comments: _____

_____

_____

_____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment, and (iii) authorize the make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20___

Manufacturer: _____

By Manufacturer's Authorized Representative:

_____
(Authorized Signature)

EQUIPMENT MANUFACTURER'S CERTIFICATE OF INSTALLATION TESTING AND INSTRUCTION

OWNER

PROJECT

CONTRACT NO.

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

_____
(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial No.)

Installed for the subject project has have been installed in a satisfactory manner, has have been satisfactorily tested, is/are ready for operation, and that Owner assigned operating personnel have been suitably instructed in the operation, lubrication, and care of the units on Date:

_____ Time: _____.

CERTIFIED BY: _____ DATE: _____
(Signature of Manufacturer's Representative)

OWNER'S ACKNOWLEDGEMENT OF MANUFACTURER'S INSTRUCTION

I/We the undersigned, authorized representatives of the _____ and/or Plant Operating Personnel have received classroom and hands on instruction on the operation, lubrication, and maintenance of the subject equipment and am are prepared to assume normal operational responsibility for the equipment:

_____ DATE: _____

_____ DATE: _____

_____ DATE: _____

-- End of Section --

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UNDERGROUND ELECTRICAL DISTRIBUTION

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 B 1	(2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
ASTM B 3	(2001; R 2007) Standard Specification for Soft or Annealed Copper Wire
ASTM B 8	(2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; Errata 2007; INT 2008) National Electrical Safety Code
IEEE Std 100	(2000) The Authoritative Dictionary of IEEE Standards Terms
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)Normal Measurements

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2003) Acceptance Testing Specifications

JOHN F. KENNEDY SPACE CENTER (KSC)

KSC-STD-E-0012E	(2001) Standard for Facility Grounding and Lightning Protection (title changed from Standard for Bonding and Grounding)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C119.1	(2006) Sealed Insulated Underground Connector Systems Rated 600 Volts
NEMA RN 1	(2005) Standard for Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid

	Steel Conduit and Intermediate Metal Conduit
NEMA TC 9	(2004) Standard for Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2008; AMD 1 2008) National Electrical Code - 2008 Edition

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-758-A	(2004) Customer-Owned Outside Plant Telecommunications Cabling Standard

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 1751F-644	(2002) Underground Plant Construction

UNDERWRITERS LABORATORIES (UL)

UL 467	(2007) Standard for Grounding and Bonding Equipment
UL 486A-486B	(2003; Rev thru Aug 2006) Standard for Wire Connectors
UL 510	(2005; Rev thru Aug 2005) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514B	(2004; Rev thru Aug 2007) Standard for Conduit, Tubing and Cable Fittings
UL 6	(2007) Standard for Electrical Rigid Metal Conduit-Steel
UL 651	(2005; Rev thru May 2007) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 83	(20086) Standard for Thermoplastic-Insulated Wires and Cables
UL 854	(2004; Rev thru Oct 2007) Service-Entrance Cables

1.2 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 Std 100.

b. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

1.3 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

Sealing Material

SD-06 Test Reports

Field Acceptance Checks and Tests; G

Cable Installation Plan and Procedure

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Cable Installer Qualifications

1.4 QUALITY ASSURANCE

1.4.1 Cable Installer Qualifications

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. Provide a resume showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

1.4.2 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 Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.3 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.

1.4.3.1 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.

1.4.3.2 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.

PART 2 PRODUCTS

2.1 CONDUIT, DUCTS, AND FITTINGS

2.1.1 Rigid Metal Conduit

UL 6.

2.1.1.1 Rigid Metallic Conduit, PVC Coated

NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, and tensile strength shall be minimum 3500 psi.

2.1.2 Plastic Conduit for Direct Burial

UL 651, Schedule 40 as indicated.

2.1.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds

shall have no injurious effect upon the hands of workmen or upon materials. Inflatable bladders may be used as an option.

2.1.4 Fittings

2.1.4.1 Metal Fittings

UL 514B.

2.1.4.2 PVC Conduit Fittings

UL 514B, UL 651.

2.1.4.3 PVC Duct Fittings

NEMA TC 9.

2.2 LOW VOLTAGE INSULATED CONDUCTORS AND CABLES

Insulated conductors shall be rated 600 volts and conform to the requirements of NFPA 70, including listing requirements. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be accepted. Service entrance conductors shall conform to UL 854, type USE.

2.2.1 Conductor Types

Cable and duct sizes indicated are for copper conductors and THHN/THWN unless otherwise noted. Conductors No. 10 AWG and smaller shall be solid copper. Conductors No. 8 AWG and larger shall be stranded copper. All conductors shall be copper.

2.2.2 Conductor Material

Unless specified or indicated otherwise or required by NFPA 70, wires in conduit, other than service entrance, shall be 600-volt, Type THWN/THHN conforming to UL 83. Copper conductors shall be annealed copper complying with ASTM B 3 and ASTM B 8.

2.2.3 In Duct

Cables shall be single-conductor cable.

2.2.4 Cable Marking

Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout the cable length.

Each cable shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

Conductors shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon

cable ties and plates, heat shrink type sleeves,or colored electrical tape. Control circuit terminations shall be properly identified. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals shall be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems shall be as follows

a. 208/120 volt, three-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, three-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

c. 120/240 volt, single phase: Black and red

2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS

Shall provide a uniform compression over the entire conductor contact surface. Use solderless terminal lugs on stranded conductors.

a. For use with copper conductors: UL 486A-486B.

2.4 LOW VOLTAGE SPLICES

Provide splices in conductors with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply NEMA C119.1.

2.4.1 Heat Shrinkable Splice

Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which shall be applied in accordance with the manufacturer's written instructions.

2.4.2 Cold Shrink Rubber Splice

Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation shall not require heat or flame, or any additional materials such as covering or adhesive. It shall be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.5 TAPE

2.5.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous

temperature environment of 80 degrees C.

2.5.2 Buried Warning and Identification Tape

Provide detectable tape in accordance with Section 31 00 00 EARTHWORK.

2.6 PULL ROPE

Shall be plastic or flat pull line (bull line) having a minimum tensile strength of 200 pounds.

2.7 GROUNDING AND BONDING

2.7.1 Driven Ground Rods

Provide copper-clad steel ground rods conforming to UL 467 3/4 inch in diameter by 20 feet in length. Sectional type rods may be used for rods 20 feet or longer.

2.7.2 Grounding Conductors

Stranded-bare copper conductors shall conform to ASTM B 8, Class B, soft-drawn unless otherwise indicated. Solid-bare copper conductors shall conform to ASTM B 1 for sizes No. 8 and smaller. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment and devices in accordance with the manufacturer's published instructions and with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable. In addition to these requirements, install telecommunications in accordance with TIA-758-A and RUS Bull 1751F-644.

3.2 CABLE INSPECTION

Prior to installation, each cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable prior to installation in accordance with the cable manufacturer's recommendations.

3.3 CABLE INSTALLATION PLAN AND PROCEDURE

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature limits for installation, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, maximum allowable pulling tension, and maximum allowable sidewall bearing pressure. The Contractor shall then prepare a checklist of significant requirements which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS. Cable shall be installed strictly in accordance with the cable manufacturer's recommendations and the approved installation plan.

3.4 UNDERGROUND CONDUIT AND DUCT SYSTEMS

3.4.1 Requirements

Depths to top of the conduit shall be in accordance with NFPA 70. Run conduit in straight lines except where a change of direction is necessary. Numbers and sizes of ducts shall be as indicated. Ducts shall have a continuous slope downward toward underground structures and away from buildings, laid with a minimum slope of 3 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in structures.

3.4.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.4.3 Conduit Cleaning

As each conduit run is completed, for conduit sizes 3 inches and larger, draw a flexible testing mandrel approximately 12 inches long with a diameter less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs.

3.4.4 Galvanized Conduit Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations shall be PVC coated and shall extend from at least 2 inches within the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches from penetration).

3.4.5 Multiple Conduits

Separate multiple conduits by a minimum distance of 2 1/2 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 12 inches. Stagger the joints of the conduits by rows (horizontally) and layers (vertically) to strengthen the conduit assembly. Provide plastic duct spacers that

interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, ties, and locking device on top to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

3.4.6 Conduit and Duct Without Concrete Encasement

Provide not less than 3 inches clearance from the conduit to each side of the trench. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve. The first 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in3 to 6 inch layers. Provide color, type and depth of warning tape as specified in Section 31 00 00 EARTHWORK.

3.4.6.1 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts. Concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks.

3.4.7 Duct Encased in Concrete

Construct underground duct lines of individual conduits encased in concrete. Do not mix different kinds of conduit in any one duct bank. Concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 1/2 inches, except separate light and power conduits from control, signal, and telecommunications conduits by a minimum concrete thickness of 3 inches. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring shall be done by driving reinforcing rods adjacent to duct spacer assemblies and attaching the rods to the spacer assembly. Provide color, type and depth of warning tape as specified in Section 31 00 00 EARTHWORK.

3.5 CABLE PULLING

Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with tape or wire shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.5.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.6 CABLES IN UNDERGROUND STRUCTURES

Do not install cables utilizing the shortest path between penetrations, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure.

3.6.1 Cable Tag Installation

Install cable tags in each manhole as specified, including each splice. Tag wire and cable provided by this contract. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes.

3.7 CONDUCTORS INSTALLED IN PARALLEL

Conductors shall be grouped such that each conduit of a parallel run contains 1 Phase A conductor, 1 Phase B conductor, 1 Phase C conductor, and 1 neutral conductor.

3.8 LOW VOLTAGE CABLE SPLICING AND TERMINATING

Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set. Make splices in underground distribution systems only in accessible locations such as manholes,handholes, or aboveground termination cabinets.

3.9 GROUNDING SYSTEMS

Provide grounding system as indicated, in accordance with NFPA 70 and IEEE C2, and as specified herein.

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

Grounding metal enclosures of electrical and electrically-operated equipment	5 ohms

3.9.1 Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus 12 inches, installed to provide an earth ground of the appropriate value for the particular equipment being grounded.

If the specified ground resistance is not met, an additional ground rod shall be provided in accordance with the requirements of NFPA 70 and KSC-STD-E-0012E. (placed not less than 6 feet from the first rod). Should the resultant (combined) resistance exceed the specified resistance,

measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.9.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.9.3 Grounding Conductors

Provide bare grounding conductors, except where installed in conduit with associated phase conductors. Ground cable sheaths, cable shields, conduit, and equipment with No. 6 AWG. Ground other noncurrent-carrying metal parts and equipment frames of metal-enclosed equipment. Ground metallic frames and covers of handholes and pull boxes with a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.10 EXCAVATING, BACKFILLING, AND COMPACTING

Provide in accordance with NFPA 70 and Section 31 00 00 EARTHWORK.

3.10.1 Reconditioning of Surfaces

3.10.1.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding, and provide topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.

3.10.1.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.11 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.11.1 Concrete Slabs for Equipment

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. Slab shall be placed 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.

3.11.2 Sealing Material

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.

3.12 FIELD QUALITY CONTROL

3.12.1 Performance of Field 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.

3.12.1.1 Grounding System

a. Visual and mechanical inspection

Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

Perform ground-impedance measurements utilizing the fall-of-potential method in accordance with IEEE Std 81. 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 megohmmeter tester 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.

3.12.2 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 Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

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SECTION 40 95 00

PROCESS CONTROL SYSTEM

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.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 587	(1980) Guide/Surge Voltages/Lo-Volt.AC.Power.Circuits
IEEE C37.90	(2005) Standard for Relays and Relay Systems Associated With Electric Power Apparatus
IEEE C62.41.1	(2002; R 2008) IEEE Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE Std 142	(2007) Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book (Color Book Series)

ISA - INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ISA 5.1	(2009) Instrumentation Symbols and Identification
ISA 5.4	(1991) Instrument Loop Diagrams
ISA 50.1	(1982; R 1992) Compatibility of Analog Signals for Electronic Industrial Process Instruments
ISA S50.1	(1982; R 1992) Compatibility of Analog Signals for Electronic Industrial Process Instruments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures

NEMA ICS 1	(2000; R 2005; R 2008) Standard for Industrial Control and Systems General Requirements
NEMA ICS 2	(2000; Errata 2002; R 2005; Errata 2006) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
NEMA ICS 4	(2005) Industrial Control and Systems: Terminal Blocks

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2008; AMD 1 2008) National Electrical Code - 2008 Edition

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST SP 250	(1991) Calibration Services Users Guide

NSF INTERNATIONAL (NSF)

NSF 61	(2009) Drinking Water System Components - Health Effects

UNDERWRITERS LABORATORIES (UL)

UL 1059	(2001; Rev thru Dec 2006) Terminal Blocks
UL 508	(1999; Rev thru Sep 2008) Standard for Industrial Control Equipment
UL 489	(2009) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

1.2 SYSTEM DESCRIPTION

The process instrumentation and control system project scope includes:

Providing, fabricating, and installing a PLC-based, duplex pump control for Lift Station 10A.

Modifying the existing Government SCADA application to accommodate monitoring/control functions as specified herein and on the drawings.

The process instrumentation and control system shall facilitate monitoring and control of the process equipment as specified herein and in the drawings (i.e., P&IDs, Sequence of Operation, Control Schematics, and Details. Provide the necessary hardware configured and sized to meet the specified performance requirements.

1.2.1 General Requirements

The following is a brief description of the monitoring and control features required for each location:

Each lift station is a duplex pump configuration. Provide controls that operate the pumps based upon the wastewater level contained in the associated wet well. The Government's SCADA application shall serve to monitor the status of the pumps and the wet well features as specified herein. Implement limited control features as presented herein.

1.2.2 Operation

Provide monitoring and control features as described in the Sequence of Operation, the Control Narratives provided as an Attachment herein, and as further specified herein.

Lift Station 10A - Kennedy Space Center Visitor's Information Center.

1.2.3 Points

Inputs and Outputs to be monitored/controlled by Lift Station 10A FIC are provided in tabular form as an ATTACHMENT to this Section.

1.2.4 Data Transmission Systems (DTS)

Data Transmission between the FIC and the SCADA application shall be achieved using the KCCS Utilities Wide Area Network (WAN).

Data transmission between the FIC and the SCADA application shall use the Government's standard, Ethernet-based, communication protocol; Modbus-TCP.

1.2.5 Process Control System Sub Contractor Responsibilities

The Process Control System Sub Contractor shall complete the detailed design to achieve the performance requirements specified herein. The work includes the following tasks:

Prepare and make the submittals required herein.

Purchase, fabricate, and install equipment and ancillaries.

Provide instructions, details, and recommendations to, and coordinate with the Contractor.

Prepare new screens for and make revisions to the Government's SCADA application data base for the work specified herein. The SCADA application software is Citect.

Configure and commission all smart instruments and devices.

Verify readiness for operation.

Adjust and calibrate instruments

Perform system start up services.

Test the system and coordinate system testing with other trades, the Government, and the Contracting Officer.

Train the Government's staff in system operation and maintenance.

1.3 DEFINITIONS

a. General: Definitions, symbols, and engineering unit abbreviations shall conform to ISA 5.1, as applicable.

b. Abbreviations:

CP:	Control Panel
FP:	Field Panel
HMI:	Human/Machine Interface
ISA:	Instrumentation Society of America
I/O:	Inputs and Outputs
KCCS:	Kennedy Complex Communication System
MCC:	Motor Control Center
OIU:	Operator Interface Unit
ORT:	Operational Readiness Test
PAT:	Performance Acceptance Test
PICS:	Process Instrumentation and Control System
RTU:	Remote Telemetry Unit
SCADA:	Supervisory Control and Data Acquisition

c. Terms:

1. Enclosure: Control panel, console, cabinet, or instrument housing.

2. Instructor Day: 8 hours of actual instruction time.

3. Software: Programs or configuration data for digital devices, stored in read-only memory, programmable read-only memory, read/write memory, disk, tape, or other electronic storage device.

Types of Software:

Standard Software: Package independent of the project on which they are used. Standard software includes system software and Process Monitoring and Control software.

Application Software: Configuration to provide functions unique to this project.

4. Rising/Falling: Terms used to define actions of discrete devices about their set points.

Rising: Contacts close when an increasing process variable rises through set point.

Falling: Contacts close when a decreasing process variable falls through set point.

d. Signal Types:

Analog Signals, Current Type: 4 to 20 mA de signals conforming to ISA S50.1. Unless otherwise indicated for specific PICS Subsystem components, use the following ISA 50.1 options.

Transmitter Type: Number 2, two-wire.

Transmitter Load Resistance Capacity: Class L.
Fully isolated transmitters and receivers.

Analog Signals, Voltage Type: 1 to 5 volts DC within panels where a common high precision-dropping resistor is used.

Discrete Signals: Two-state logic signals using 24V DC or 120V AC sources as indicated.

Pulse Frequency Signals: Direct current pulses whose repetition rate is linearly proportional to process variable. Pulses generated by contact closures or solid state switches as indicated. Power source less than 30V DC.

Special Signals: Other types of signals used to transmit analog and digital information between field elements, transmitters, receivers, controllers, and digital devices.

e. Instrument Tag Numbers: A shorthand tag number notation is used in the Loop Specifications. For example: 10PI-2(A/B).

Notation	Explanation
10	Unit process/Loop designation
PI	ISA designator for Pressure Indicator
(2)	Unit designation; alphanumeric designation of same process types in a given loop; -1, -2 in this example
(A/B)	Component designation; Alphanumeric designation of same component type within a process; -A, -B in this example

In this example, 10PI-(2)(A/B) is shorthand for:

10PI-1-A, 10PI-1-B, 10PI-2-A, 10PI-2-B

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-02 Shop Drawings

Panel Fabrication Drawings; G
Installation Drawings; G
Field Wiring Drawings; G

In accordance with the paragraph entitled "DRAWINGS."

SD-03 Product Data

Manufacturer's descriptive and technical literature, performance charts and installation instructions. Product specific catalog cuts shall be in booklet form, indexed to the unique identifiers, and shall consist of data sheets that document compliance with the specification. Where multiple components are shown on a catalog cut, the application specific component shall be marked.

Training Manual; G

Instruction manual within 30 days of Notice to Proceed.

Performance Verification Test (PVT); G

The performance verification test procedure; it shall refer to the actions and expected results to demonstrate that the control system performs in accordance with the sequence of control. Include 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.

SD-05 Design Data

Control Drawings; G

Provide ladder logic or other logic diagrams reflective of the hardwired logic proposed.

Submit PLC code and color graphic screens representative of the work described herein. Provide the PLC code in the hardware programming language and containing example functions or routines representative of those proposed for this work. Provide using Citect Graphics Builder. Include the navigation map(s), Genies, Super Genies, Cicode functions, and metadata proposed for this work. Provide a submittal that is reproducible, hard-copy as a minimum.

SCADA Application 90 Percent Development Submittal; G

Submit the completed PLC code and color graphic screens for the work described herein. Provide the PLC code in the hardware programming language. Provide the screens using Citect Graphics Builder. Include the navigation map(s), Genies, Super Genies, Cicode functions, and metadata proposed for this work. Provide a submittal that is reproducible, hard-copy as a minimum. Demonstrate the operation of the programmed system complete. Provide computing hardware (i.e., laptop computer). Ensure the submittal also includes one electronic copy of the operational Citect project.

SCADA Application Metadata; G

Submit the metadata for all points monitored/controlled by the Government's existing SCADA application. The Contracting Officer will provide an example presentation of metadata from previous work. Provide a presentation of the metadata that complies with this example, is clearly and logically organized, and clearly describes the monitored/controlled data. Use this data to facilitate the integration of the Citect projects unique to this

work with the Government's overall SCADA application.

SD-06 Test Reports

Testing, Adjusting and Commissioning; G
Performance Verification Test (PVT); G

SD-07 Certificates

Submit names, resumes, certificates, or other documents descriptive of the technicians' and supervisor's qualifications with respect to programming and configuring of Citect SCADA. Provide documentation in accordance with the paragraph entitled "QUALIFICATIONS.":

List of project programming/configuring Citect SCADA, completed within the last 3 years.

Certificates of Completion:

Citect HMI/SCADA configuration training
Cicode Programming

Programming Supervisor contact information (name, address, mobile phone).

SD-10 Operation and Maintenance Data

Instrumentation and Control System

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.

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs and trouble shooting guides.

SD-11 Closeout Submittals

Submit Record Drawings for the completed work.

Deliver to the Contracting Officer two, full license and executable copies of the software used to configure/program the PLC and OIU.

Submit an annotated copy of the programming code implemented for the FIC. Provide a submittal that is both paper and in electronic format. Ensure that the electronic formal submittal is in a form suitable for access and editing with the FIC hardware programming software.

1.5 SITE ENVIRONMENTAL CONDITIONS

a. Location; Kennedy Space Center

1. Latitude 28.62
2. Longitude 80.72
3. Altitude (above MSL) 16 ft

b. Outside Design Conditions

1. Winter Design Temperature: 35 degrees F

2. Summer Design Temperature: T_{db} = 90 degrees F, T_{wb} = 78 degrees F

c. Inside Design Conditions, Air Conditioned

1. Winter Design Temperature: 62 degrees F
2. Summer Design Conditions: T_{db} = 90 degrees F, T_{wb} = 78 degrees F

d. Inside Design Conditions, Non-Air Conditioned

1. Winter Design Temperature: 45 degrees F
2. Summer Design Conditions: T_{db} = 90 degrees F, T_{wb} = 78 degrees F

1.6 SEQUENCING

No specific requirements.

1.7 DRAWINGS

Panel Fabrication Drawings: Detailed drawings illustrating sufficient information for a panel shop to purchase the component parts and fabricate/wire the panel.

Installation Drawings: Detailed drawings illustrating how instruments, panels, and other components are to be installed in the field, complete.

Field Wiring Drawings: Detailed drawings illustrating the termination of analog and discrete signals for instruments and panels in the field. As a minimum, the field wiring drawings shall include 'Analog Loop Diagrams', in compliance with ISA 5.4.

1.8 QUALIFICATIONS

List of project programming/configuring Citect SCADA, completed within the last 3 years.

Certificates of Completion:

Citect HMI/SCADA configuration training
Cicode Programming

Programming Supervisor contact information (name, address, mobile phone).

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

First Named Manufacturer: PICS design is based on first named manufacturers of equipment and materials.

1. If an item is proposed from other than first named manufacturer, obtain approved from Contracting Officer for such changes in accordance with paragraph entitled "Submittals".

2. If proposed item requires change in system design, (i.e., different installation, wiring, raceway, enclosures, intrinsically safe barriers, and accessories), the PICS contractor shall be responsible for any additional cost. The PICS contractor shall first obtain approval from the Contracting officer before furnishing equipment and work.

Use product of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.

Implement all same or similar functions in same or similar manner. For example, control logic, sequence control, and display layouts.

2.2 GENERAL REQUIREMENTS

The diagrams, as shown in the drawings, are diagrammatic and supplement PICS performance requirements.

PICS functions are as shown on the drawings and as described herein. Furnish equipment items as required. Furnish all materials, equipment, and software necessary to affect required system and loop performance.

Equipment located outdoors, not provided with climate controlled enclosure, shall be capable of operating in the ambient temperature range indicated in paragraph SITE ENVIRONMENTAL CONDITIONS - Outdoor Conditions, unless otherwise specified.

Equipment located inside a structure or building facility without air conditioned environment shall be capable of operating in the ambient temperature range indicated in paragraph ENVIRONMENTAL CONDITIONS - Indoor, Non-Air Conditioned, unless otherwise specified.

Equipment located inside a structure or building facility with air conditioned environment shall be capable of operating in the ambient temperature range indicated in paragraph ENVIRONMENTAL CONDITIONS - Indoor, Air Conditioned, unless otherwise specified.

Electrical equipment will conform to Division 26 ELECTRICAL. 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.

2.3 NAMEPLATES

Provide the manufacturer's name and address and the model and serial number on each major component of equipment in a conspicuous place.

Nameplates shall be laminated plastic and shall identify the device, such as pump "P-1" or valve "VLV-402". Nameplates shall be 1/8 inch thick, white with black center core, 1 by 3 inches in size as a minimum, 1/4 inch high engraved block lettering.

Attach nameplates for devices smaller than 1 by 3 inches using a nonferrous metal chain. All other nameplates shall be physically attached (screwed) to the device.

Coordinate labels with the schedules and the process and instrumentation drawings.

2.4 SCHEDULES

Listed below are schedules included as an ATTACHMENT to this Section. The Contractor shall consider these sections as integral to this Section.

2.4.1 General Control Narratives

A description of common functions (motor start/stop, valves open/close, etc.) to be implemented for this work, including the operator interface required at the FIC or SCADA Application.

2.4.2 Instrument List

Major components for each loop are listed in the Instrument List referenced in Article ATTACHMENT. Furnish all equipment that is necessary to achieve required loop performance.

2.4.3 FIC Input/Output List

The Input/Output for each FIC are listed in the FIC Input/Output List referenced in Article ATTACHMENT. Furnish all equipment and labor necessary to achieve the required FIC Input/Output.

2.4.4 Component Specifications

Generalized specifications for each type of component are located in Article ATTACHMENT.

2.5 CONTROL PANELS

2.5.1 Panel Assembly

Control panels shall be factory assembled and shipped to the jobsite as a single unit. Panels shall be fabricated as indicated and devices shall be mounted as shown or required. Each panel shall be fabricated as a bottom-entry connection point for control system electrical power, control system wiring, communications system wiring to KCCS.

2.5.2 Components

2.5.2.1 Enclosures

The enclosure for each control panel shall conform to the requirements of NEMA 250 for the types specified. Finish the enclosure outside with white baked epoxy. Damaged surfaces shall be repaired and refinished using original type finish.

Enclosures shall be Type 3R.

Provide enclosure with a single, continuously hinged exterior door with print pocket, 3-point latching mechanism and key lock.

Cutouts shall be cut, punched, or drilled and finished to have smooth rounded edges.

2.5.2.2 Pilot Devices

Indicator lights, NEMA 4 rated, complying with NEMA ICS 1, NEMA ICS 2 and UL 508. Lights shall be heavy duty, round and shall mount in a 0.875 inch mounting hole. Indicator lights shall be LED type and shall operate at 120 vAc or 24 vDc. Long life bulbs shall be used. Indicator light shall be provided with a legend plate labeled as shown on the drawings. Lens color shall be as indicated on the drawings. Lights shall be push to test (lamp) type.

Selector switches, NEMA 4 rated, complying with NEMA ICS 1, NEMA ICS 2 and UL 508. Selector switches shall be heavy duty, round and shall mount in a 0.875 inch mounting hole. The number of positions shall be as indicated on the drawings. Switches shall be non-illuminated. Switches shall be rated for 600 volts, 10 amperes continuous. Selector switches shall be provided with a legend plate labeled as shown on the drawings. Where indicated or required, dual auxiliary contacts shall be provided for the automatic position to provide position sensing at the central station or workstation. Auxiliary contacts shall be rated for 120 vAc, 1A as a minimum.

Push buttons, NEMA 4 rated, complying with NEMA ICS 1, NEMA ICS 2 and UL 508. Push buttons shall be heavy duty, round and shall mount in a 0.875 inch mounting hole. The number and type of contacts shall be as indicated on the drawings or required by the Sequence of Operation. Push buttons shall be rated for 600 volts, 10 amperes continuous. Push buttons shall be provided with a legend plate labeled as shown on the drawings.

2.5.2.3 Relays

Relays shall comply with IEEE C37.90 and derated for altitude above 1,500 m. Relays shall be double-pole, double-throw (DPDT). Relay coil shall be 120 vAc and shall be provided with matching mounting socket. Power consumption shall not be greater than 3 watts.

2.5.2.4 Terminal Blocks

Terminal blocks shall comply with NEMA ICS 4 and UL 1059. 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. Terminal blocks shall be made of bakelite or other suitable insulating material with full deep barriers between each pair of terminals. A terminal identification strip shall form part of the terminal block and each terminal shall be identified by a number in accordance with the numbering scheme on the approved wiring diagrams.

2.5.2.5 Alarm Horns

Alarm horns shall be provided where indicated on the drawings. Horns shall be vibrating type and shall comply with UL 508. Horns shall provide 100 dB

at 10 feet. 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.

2.5.2.6 Hour Meter

Hour meter shall provide a totalized readout of the number of hours of operation for the equipment monitored. Meter shall provide readout with a minimum of seven (7) digits including 1 decimal place. The display shall be non-resettable. The meter shall be driven by a 120 vAc synchronous motor.

2.5.3 Electrical Requirements

Each panel shall be powered by a dedicated separate 120 VAC circuit, or 120 VAC from a leg of the 3-phase power supply via a control power transform appropriately sized for the anticipated loads, and provided in the panel enclosure. Protect the control power feed with a fuse sized appropriately for the anticipated loads. Provide a suitable disconnect switch internal to the panel for the control power. Electrical work shall be as specified in Division 26 ELECTRICAL and as shown on the drawings.

Certifications or Ratings: All I&C and electrical components, terminals, wires, and enclosures shall be UL recognized or UL listed.

Circuit Breakers: In compliance with NEMA AB 1 and UL 489 35,000 RMS symmetrical rating, minimum at 480 volts, unless otherwise specified. Tripping indication; Operator handle position.

Non-Motor Branch Circuit Breakers: Molded case thermal magnetic.

Motor Branch Circuit Breakers: Molded case with manufacturer's recommended trip setting for maximum motor protection.

50 horsepower or less: Magnetic

Larger than 50 horsepower: Thermal magnetic with adjustable magnetic trips.

Padlock provisions: OPEN position.

Wire within Enclosures:

AC Circuits:

Type: 300-volt, Type MTW stranded copper.
Size: For current to be carried but not less than No. 18-AWG.

Analog Signal Circuits:

Type: 300-volt stranded copper, twisted shielded pairs.
Size: No. 18-AWG minimum.

Other DC Circuits:

Type: 300-volt, Type MTW stranded copper.
Size: No. 18-AWG minimum.

Special Signal Circuits: Use manufacturer's standard cables.

Wire Identification: Numbered and tagged at each termination.

Wire Tags: Snap-on or slip-on PVC wire markers with legible machine printed markings and numbers. Adhesive or taped-on tags are not acceptable.

Wire entering or leaving enclosures, terminate and identify as follows:

Analog and discrete signal, terminate at numbered terminal blocks.

Special signals terminated using manufacturer's standard connectors.

Identify wiring in accordance with Division 26 ELECTRICAL.

Terminal Blocks for Enclosures:

General:

Provide sufficient terminal blocks necessary to accommodate present, indicate future, and spares, as specified below. Land no more than one (1) wire per terminal block. Wire spare and unused panel mounted elements to their panels' terminal blocks.

Provide twenty (20) percent of all connected terminals but not less than 5 per terminal blocks as spares.

Common Terminal Blocks Configuration:

Connection Type: Screw compression clamp.

Compression clamp: Complies with DIN-VDE 0611. Hardened steel clamp with transversal groves that penetrate wire strands providing a vibration-proof connection. Clamp shall guide strands of wire into terminal.

Screws: Hardened steel, captive and self-locking.

Current Bar: Copper or treated brass.

Insulation: Thermoplastic rated for -10 to 120 degrees F. Insulation shall be shaped at inputs to facilitate wire entry.

Mounting: Stranded DIN rail, suitable to allow Terminal block extraction from an assembly without displacing adjacent blocks.

End Stops: Minimum of one at each end of rail.

Wire Preparation: Stripping only permitted.

Jumpers: Allow jumper installation without loss of space on terminal or rail.

Marking System:

Terminal number shown on both sides of terminal block. Allow use of preprinted and field marked tags. Mark terminal block and terminal strip numbers as shown on Panel Control Diagrams and Loop Diagrams.

Mark the top of fuse protected terminal blocks with fuse voltage and amperage.

Test Plugs: Soldered connections for 18-AWG wire.

Pin Diameter: 0.079 inch.

Terminal Block, General-Purpose:

Rated Voltage:	600V AC
Rated Current:	30 amp
Wire Size:	22- to 10-AWG
Rated Wire Size:	10-AWG
Color:	Grey body
Spacing:	0.25 inch, maximum
Test Sockets:	One screw test socket 0.079-inch diameter
Manufacturer and Product:	Entrelec; Type M4/6.T

Terminal Block, Ground:

Wire Size:	22- to 10-AWG
Rated Wire Size:	10-AWG
Color:	Green and yellow body
Spacing:	0.25 inch, maximum
Grounding:	Ground terminal blocks electrically grounded to the mounting rail
Manufacturer and Product:	Entrelec; Type M4-6.P

Terminal Block, Blade Disconnect Switch:

Rated Voltage:	600V AC
Rated Current:	10-amp
Wire Size:	22- to 12-AWG
Rated Wire Size:	12-AWG
Color:	Grey body, orange switch
Spacing:	0.25 inch, maximum
Manufacturer and Product:	Entrelec; Type M4/6.SN.T

Terminal Block, Fused, 24V DC:

Rated Voltage:	600V DC
Rated Current:	16-amp
Wire Size:	22- to 10-AWG
Rated Wire Size:	10-AWG
Color:	Grey body
Fuse:	0.25 inch by 1.25 inch
Indication:	LED diode 24V DC
Spacing:	0.512 inch, maximum
Manufacturer and Product:	Entrelec; Type M10/13T.SFL

Analog Signal Isolators: Furnish signal isolation for analog signals that are sent from one enclosure to another. Do not wire in series instruments on different panels, cabinets, or enclosure.

Power Distribution within Enclosures:

Feeder Circuits: One or more 120V AC, 60-Hz feeder circuits. Make

provisions for feeder circuit conduit entry. Furnish terminal board for termination of wires.

Power Panel: Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel. Locate to provide clear view of and access to breakers when door is open.

Breaker sizes: Coordinate such that fault in branch circuit will blow only branch breaker but not trip the main breaker. Branch circuit breakers shall be 15 amps to 250 VAC, maximum/

Breaker Manufacturers and Products: Square D, Type QO.

Circuit Wiring: Use following rules for actual circuit wiring:

Devices on Single Circuit: 20, maximum.

Multiple Units Performing Parallel Operations: To prevent failure of any single branch circuit from shutting down entire operation do not group all units on the same branch circuit.

Branch Circuit Loading: 12 amperes continuous, maximum.

Panel Lighting and Service Outlets: Put on separate 15-amp, 120V AC branch circuit.

Provide 120-volt AC plugmold for panel components with line cords.

Signal Distribution:

Within Panels: 40 to 20 mA DC signals may be distributed as 1 to 5V DC.

Outside Panels: Isolated 4 to 20 mA DC only.

Signal Wiring: All signal wiring twisted in shielded pairs.

Signal Switching:

Use dry circuit type relays or switches.
No interruption of 4 to 20 mA loops during switching.
4 to 20 mA DC Signals: 0.2 mA, maximum.
1 to 5V DC Signals: 0.05V, maximum.

Power Supplies:

Furnish to power instruments requiring external DC power, including two-wire transmitters and DC relays. Convert 120V AC, 60-Hz power to DC power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances. Provide output over voltage and over current protective devices to:

Protect instruments from damage due to power supply failure.
Protect power supply from damage due to external failure.

Power supply enclosures shall be NEMA 1 rated in accordance with NEMA 250. Mount such that dissipated heat does not adversely affect other components.

Provide a fuse on the DC supply line to each individual two-wire transmitter in an indicating holder or terminal block. Mount so fuses can be easily seen and replaced.

Electrical Transient Protection:

The electrical transient protection device shall serve to protect elements of PICS against damage due to electrical transients induced in interconnecting lines by lightning and nearby electrical systems. Provide, install, coordinate, and inspect grounding of surge suppressors at:

Connection of AC power to PICS equipment including panels, console assemblies, and field mounted analog transmitters and receivers.

At the field and panel, console, or assembly connection of signal circuits that have portions of the circuit extending outside of a protective building.

Connection of phone line to PICS equipment.

All surge suppressors and related enclosures shall be furnished by the PICS Contractor and installed under Division 26, ELECTRICAL. Install in accordance with manufacturer's instructions and installation details provided in the drawings.

Grounding equipment, installation of grounding equipment, and terminations for field mounted devices are provided under Division 26, ELECTRICAL.

The electrical transient protection device shall be multistage hybrid type responding to a surge within 5 nanoseconds maximum. The device shall recover automatically and shall be suitable for operating within a temperature range of -20 degrees C to 85 degrees C.

Power supply (120 VAC, 60-Hz, single-phase) electrical transient protection devices shall be tested and rated for a minimum of 50 occurrences of IEEE Std 587 Category B test waveform and shall have a first-stage clamping voltage rating of 350 volts or less and second-stage clamping voltage rating of 210 volts or less.

The power supply electrical transient protection device shall be suitable for continuous operation 30 amps minimum at 130 V AC.

Encapsulate the devices in flame-retardant epoxy.

Test analog signal lines (1 - 5 VDC or 4 - 20 mA) electrical transient protection devices using a linear waveform, 8 microsecond rise in current from 0 amp to a peak current value followed by an exponential decay of current reaching one-half peak value in 20 microseconds. Test and rate the device for 50 occurrences of 2,000-amp peak test waveform.

The device shall exhibit DC clamping 20 to 40 percent above operating voltage for circuit with a tolerance of less than plus/minus 10 percent. The unit shall have a maximum loop resistance of 18 ohms per conductor.

The devices shall be suitable for both field and panel installation. The field-mounted device electronics shall be epoxy-potted

(flame-retardant) and encased in a stainless-steel pipe nipple. The panel-mounted device electronics shall be epoxy-potted (flame retardant, suitable for panel or DIN rail mounting).

Field-mounted, two-wire devices shall be EDCO Model No. SS64-036-2, or equal.

Panel-mounted devices shall be EDCO Model No. PC642 or EDCO Model No. COHOP-036 mounted on compatible mounting blocks or equivalent.

Provide field-mounted four-wire transmitters, e.g. magnetic flowmeter or analyzers (indoor and outdoors) with units that afford hybrid AC power protection and signal line protection in a single NEMA 4X fiberglass enclosure. The combination surge protection units shall be EDCO Model No. SLAC-32036 or approved equal. All signal lines must have surge protections at both panel and field sensor end.

Wiring Within an Enclosure:

Restrain all wiring by plastic ties or ducts or metal raceways. Do not exceed manufacturer's fill recommendations when using plastic ducts or metal wireways. Secure wire passing over a hinged joint at each end so that bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.

Arrange wiring neatly, cut to proper length, and remove surplus wire. Provide abrasion protection for wire bundles which pass through holes or across edges of sheet metal.

Use locking-fork-tongue or ring-tongue lugs when making connections to screw type terminals. Use manufacturer's recommended tool with required sized anvil to make crimp lug terminations. Terminate a maximum of one (1) wire per crimp lug, two (2) per screw terminal.

Strip, prepare, and install wires in accordance with terminal manufacturer's recommendations when making connections to compression clamp type terminals. Terminate a maximum of one (1) wire per terminal.

Splice or tap of wires at device terminals or terminal blocks only.

Terminate 24V DC and analog signal circuits on separate terminal block from AC circuit terminal blocks.

Separate analog and DC circuits by at least 6 inches from AC power and control wiring except at unavoidable crossover points and at device terminations.

Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.

2.5.4 Grounding

Provide a solid copper ground bus for each control panel enclosure. Anchor the ground bus securely to the enclosure so as to effectively ground the entire structure. Clamp-type terminals sized large enough to carry the maximum expected current shall be provided on the ground bus for grounding cables. 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. Cases of instruments, relays and other devices shall be effectively grounded through the enclosures steel structure unless otherwise indicated. Insulated wiring having a continuous rated current of not less than the circuit fuse rating shall be used for grounding. Grounding terminals of power receptacles shall be solidly grounded to the panel enclosure.

2.5.5 Convenience Outlet

Provide one 120 volt ac, 20 amp, ground fault interruption (GFI) type duplex convenience outlet inside the panel. The outlet circuit shall be separate from the panel power circuit.

2.5.6 Panel Interior Light

Provide one 40 watt fluorescent light in any control panel 12 cubic feet in volume or greater. The light shall be operated by a manual on-off switch mounted on the interior door of the enclosure. The light shall be powered by the same circuit as the convenience outlet.

2.5.7 Temperature Control

Size enclosures to adequately dissipate heat generated by equipment mounted on or inside.

Provide and install thermostatically controlled heaters to maintain internal temperature above 40-degrees F for all enclosures located outside or in unheated areas.

PART 3 EXECUTION

3.1 SCADA APPLICATION DEVELOPMENT

3.1.1 Pre-Development Meeting

The Contractor and their SCADA Development Team shall meet with the Contracting Officer before commencing any programming or configuration efforts with respect to the SCADA Application. At this meeting the Contracting Officer will supply the Contractor with the Government's SCADA graphic and data standard, example graphical screen, Genies, Super Genies, Cicode functions, and metadata for use on this work. This submittal shall be reproducible, hard-copy as a minimum.

The Contracting Officer will confirm the version of the SCADA application software. At the time of publication, the SCADA application software is Citect Version 6.1.

3.1.2 50 Percent Development Coordination Meeting

The Contractor and the SCADA Application Development Team shall attend a meeting with the Contracting Officer and team to review the SCADA Application 50 Percent Development Submittal. At that meeting, the Contractor and SCADA Application Development Team shall be prepared to discuss options available to the Government with respect to the configuration, presentation, and control of data graphically on the Government's SCADA application. A consensus will be reached and forwarded onto the Contractor in writing after the meeting. These shall be implemented in the SCADA Application for this project and submitted as the SCADA Application 90 Percent Development Submittal.

3.1.3 90 Percent Development Coordination Meeting

The Contractor and the SCADA Application Development Team shall attend a meeting with the Contracting Officer and their team to review the SCADA Application 90 Percent Development Submittal. The Contractor and SCADA Application Development Team shall perform a live demonstration of the SCADA Application developed for this project. Provide hardware (laptop computer) and software necessary for the demonstration. The Contracting Officer and team shall have the opportunity to operate the application to their satisfaction. A consensus will be reached and forwarded onto the Contractor in writing after the meeting. These shall be implemented in the SCADA Application for this project.

3.1.4 Field Testing

The Contractor and the SCADA Application Development Team shall demonstrate the operation of the SCADA Application in the field as part of the Performance Verification Test (PVT). The Contractor shall provide a computer, complete with Citect SCADA and the specific application developed for the work. The Contractor shall demonstrate to the Government the full function of the SCADA application while communicating with the FIC using the Government's standard communication protocol.

3.1.5 Transfer of SCADA Application

The Contractor shall deliver, in electronic format, a fully documented version of the SCADA Application, complete, to the Contracting Officer for integration in the Government's overall SCADA Application. The Government will perform the final integration of the SCADA Application project prepared for this work.

3.2 EQUIPMENT INSTALLATION REQUIREMENTS

3.2.1 Installation

Install system components and appurtenances in accordance with the manufacturer's instructions and shall provide necessary interconnections, services, and adjustments required for a complete and operable system. Instrumentation and communication equipment and cable grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation. Adjust or replace devices not conforming to the required accuracies. Factory sealed devices shall be replaced (rather than adjusted). Wiring in exposed areas, including low voltage wiring, shall be installed in metallic raceways or EMT conduit as specified in Division 26 ELECTRICAL. Wiring in air plenum areas installed without conduit shall be plenum-rated in accordance with NFPA 70.

3.2.1.1 Isolation, Penetrations and Clearance from Equipment

Dielectric isolation shall be provided where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exteriors shall be made watertight. Holes in concrete, brick, steel and wood walls shall be drilled or core drilled with proper equipment; conduits installed through openings shall be sealed with materials which are compatible with existing materials. Openings shall be sealed with materials which meet the requirements of NFPA 70 and Division 26 ELECTRICAL. Installation shall provide clearance for control-system maintenance. Control system installation shall not interfere with the

clearance requirements for mechanical and electrical system maintenance.

3.2.1.2 Device Mounting

Devices shall be installed in accordance with manufacturers' recommendations and as shown. 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. Any deviations shall be documented and submitted to the Government for approval prior to mounting. Damaged insulation shall be replaced or repaired after devices are installed to match existing work. Damaged galvanized surfaces shall be repaired by touching up with zinc paint.

3.3 INSTALLATION OF EQUIPMENT

Install equipment as specified, as shown and as required in the manufacturer's instructions for a complete and fully operational control system.

3.3.1 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.

3.3.2 Flow Measuring Device

Fluid flow instruments shall be installed in accordance with manufacturer's recommendations, unless otherwise indicated in the specification. The minimum straight unobstructed piping for the flowmeter installation shall be 10.0 pipe diameters upstream and 5.0 pipe diameters downstream. 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.

3.3.3 Level Instruments

Level instruments shall be installed in accordance with manufacturer's recommendations, unless otherwise indicated in the specifications.

3.3.3.1 Non-Mercury Float Switches

Switches shall be mounted in accordance with manufacturer's published instructions. Procedures shall be those used for equipment in hazardous locations.

3.3.3.2 Ultrasonic Sensor

Sensor shall be installed vertically in the top of the tank and in accordance with the manufacturer's instructions. Switches shall be accessible for maintenance and calibration. 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. Sensor shall be positioned to maximize the return echo signal and minimize vessel obstructions in the sensors line of sight. The minimum recommended distance from the tank fill opening and from the side of the tank shall be maintained .

3.3.4 Pressure Instruments

Pressure sensors and pressure transducers shall be verified by calibration. All pressure taps shall incorporate appropriate snubbers. Pressure sensors and pressure switches shall have valves for isolation, venting, and taps for calibration. Pressure switches and pressure transducers installed on liquid or steam lines shall have drains. Pressure transducers, differential pressure sensors and differential pressure switches shall have nulling valves. Pressure switches shall be adjusted to the proper setpoint and shall be verified by calibration. Switch contact ratings and duty shall be selected for the application.

3.3.5 Electric Power Devices

3.3.5.1 Potential and Current Transformers

Install potential and current transformers in enclosures unless otherwise shown. Current transformer leads shall be shorted when they are not connected to the measurement circuits.

3.3.5.2 Hour Meters

Meters shall be located in the control panel or as otherwise shown. Power to the meter shall be connected to the motor starter auxiliary contacts for pumps, blowers and other motor driven devices. For devices without motor starters, the meter shall be connected in parallel with the load. Where the meter voltage differs from the metered devices voltage, transformer shall be provided as necessary.

3.3.5.3 Transducers

Transducers shall be wired in accordance with the manufacturer's instructions, and installed in enclosures.

3.3.6 Output Devices

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. Where H-O-A and/or override switches on the drawings or required by the control sequence, 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.

3.3.7 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.

3.3.8 Transformers

Transformers for control voltages 120 vAc or less shall be fed from the nearest power panel or motor control center, using circuits provided for the purpose. Provide a disconnect switch on the primary side and a fuse on the secondary side. Transformers shall be enclosed in a steel cabinet with conduit connections.

3.4 WIRE, CABLE AND CONNECTING HARDWARE

3.4.1 Metering and Sensor Wiring

3.4.1.1 Power Line Surge Protection

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.

3.4.1.2 Sensor and Control Wiring Surge Protection

Digital and analog inputs shall be protected against surges induced on control and sensor wiring. Digital and analog outputs shall be protected against surges induced on control and sensor wiring installed outdoors and as shown. Fuses shall not be used for surge protection.

3.5 CONTROL DRAWINGS

Provide control drawings, reproducible, with corresponding CADD files 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 prepared in typed form, reproducible, with corresponding word processor files and posted beside the diagrams. Diagrams and instructions shall be submitted prior to posting.

3.6 FIELD TESTING AND ADJUSTING EQUIPMENT

Provide personnel, equipment, instrumentation, and supplies necessary to perform site testing. The Government will witness the PVT, 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, during PVT shall be turned over to the Government at the conclusion of each phase of testing prior to Government approval of the test. The test procedures shall cover actual equipment and functions specified for the project.

3.6.1 Testing, Adjusting and Commissioning

Upon completion of the installation, test, adjust, and commission each control loop and system in accordance with NIST SP 250 and shall verify proper operation of each item in the sequences of operation, including hardware and software. 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. Test installed ground rods as specified in IEEE Std 142. 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. Verify operation of systems in the specified failure modes upon Control system network failure or loss of power, and verify that systems return to control system control automatically upon a resumption of control system network operation or return of power. 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 PVT. The report shall also include a copy of the approved PVT procedure.

3.6.2 Performance Verification Test (PVT)

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. 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. The test procedure shall be site specific and based on the inputs and outputs, required calculated points and the sequence of control. Demonstrate that the completed Control system complies with the contract requirements. All physical and functional requirements of the project including communication requirements shall be demonstrated and shown. Demonstrate that each system operates as required in the sequence of operation. 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. Upon successful completion of the PVT, deliver test reports and other documentation as specified to the Government.

3.7 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.

3.8 FIELD TRAINING

Field training oriented to the specific system shall be provided for designated personnel. A copy of the training manual for each trainee plus two additional copies shall be delivered to the Contracting Officer. Manuals shall include an agenda, the defined objectives for each lesson, and a detailed description of the subject matter for each lesson. Furnish audiovisual equipment and other training supplies and materials. Copies of the audiovisuals shall be delivered with the printed training manuals. The Government reserves the right to videotape training sessions for later use. 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. Approval of the Contractor's training schedule shall be obtained from the Government at least 30 days before the training.

3.8.1 Preliminary Operator Training

Prior to the start of field testing, preliminary operator training shall be taught at the project site for one training day. 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. This course shall include: general system architecture; functional operation of the system, including workstations; operator commands; application programs, control sequences, and control loops; database entry and modification; reports generation; alarm reporting; diagnostics; and historical files.

3.8.2 Additional Operator Training

Following the field testing, provide one 4-hour classroom instruction session for operator questions and training consisting of one 2-hour morning session and one 2-hour afternoon session. Instruction shall consist of "hands-on" training under the constant monitoring of the instructor. Classroom training shall include instruction on the specific hardware configuration of the installed control system and specific instructions for operating the installed system.

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.

Report the skill level of each student at the end of this course.

3.8.3 Maintenance Training

Provide one 4-hour training session by a factory representative or a qualified Contractor trainer on maintenance of the equipment. The training shall include: physical layout of each piece of hardware, calibration procedures, preventive maintenance procedures, schedules, troubleshooting, diagnostic procedures and repair instructions.

3.9 ATTACHMENTS

3.9.1 Control Narratives

General: This section covers functions to be implemented at the project as a whole. These functions pertain to the coverall display and handling of data/events.

FIC Operator Interface

Display Alarm and Status events received as discrete inputs.

Display all monitored parameters received as analog inputs.

Provide LOCAL/REMOTE indication. LOCAL operations means control at the process equipment only. REMOTE operation means remote control via RTU only.

SCADA Application Display:

Display Alarm and Status events received as discrete inputs.
Display all monitored parameters received as analog inputs.
Provide LOCAL/REMOTE indication.

FIC Program Features:

Maintain all Operator entered values (i.e. set points, process, warnings, alarms, and notices).

Maintain Operator control commands (i.e. manual/automatic mode) control.

Upon restoration of power hold all valves at last position and STOP motors. Confirm that the motors have come to a complete stop and all instruments have completed their initialization. Restart the process in a controlled sequence. The sequence will be provided by the Contracting Officer. Restore control to meet current operating conditions and operator setpoint values. Maintain setpoint at values entered before power loss.

Maintain all ALARM and FAIL conditions until the alarming event has cleared and the condition is manually RESET local to the FIC.

Common Control Functions:

Below is a description of control function(s) to be used throughout the project regardless of unit process assignment. Where required, these functions will be referenced in the Sequence of Operation by the title(s) provided below. Implement the control functions in the FIC and implement the Operator Interface requirements both at the FIC Operator Interface Unit and the SCADA Application.

START/STOP Motor Control, Non-Reversing:

FIC Operator Interface

START/STOP/AUTO selection
ON/OFF status indication
FAIL alarm event

SCADA Application Display

ON/OFF status indication
FAIL alarm event

FIC Control Functions

Manual Mode: Continuously operate the motor whenever the START/STOP selector is in the START mode. Stop motor operation whenever the START/STOP selector is in the STOP mode. STOP the motor whenever a FAIL alarm event occurs (see below).

AUTO mode: START/STOP the motor in response to internal command signal. Command signal will be identified in Sequence of Operation. STOP the motor whenever a FAIL alarm event occurs (see below).

Establish a FAIL event when any of the following occur:

The START/STOP status is not achieved with an adjustable delay after the START/STOP command is issued.

Suction pressure is below a preset value for an operator adjustable period of time.

Differential pressure across the pump exceeds a preset value for an operator adjustable period of time.

The starter has a fail or fault condition.

3.9.2 Instrumentation List

Comp. Code	Tag No.	Component Title	Options	Installation Detail No.
L5	10A-LIT-1	Level Element and Transmitter, Ultrasonic	Range: 0 to 30 feet	13383A
			Connection: Flanged	13383B
			Element Material: PVDF	
			Process Liquid: Potable Water	

Comp. Code	Tag No.	Component Title	Options	Installation Detail No.
L8	10A-LSHH-1	Level Float Switch	Cable Length: 50 feet, min	13248
	10A-LSH-1		Set Point: Coordinate In Field	
	10A-LSM-1		Mounting: Suspended	
	10A-LSL-1		Process Liquid: Potable Water	
	10A-LSLL-1		Options: NSF 61 Certified	
			Element Material: As Specified	
			Damping: Not Required	
			Process Liquid: Potable Water	
			Process Liquid: Potable Water	

3.9.3 PLC Input/Output List

Tag Number	Type	I/O	Description	PLC Register	Notes
10A-LIT-1	ANALOG	INPUT	Water Level, LS-10A Wet Well		
10A-LSHH-1	DISCRETE	INPUT	Water Level HIGH HIGH, LS-10A Wet Well		
10A-LSH-1	DISCRETE	INPUT	Water Level HIGH, LS-10A Wet Well		
10A-LSM-1	DISCRETE	INPUT	Water Level Medium, LS-10A Wet Well		
10A-LSL-1	DISCRETE	INPUT	Water Level LOW, LS-10A Wet Well		
10A-LSLL-1	DISCRETE	INPUT	Water Level LOW LOW, LS-10A Wet Well		
10A-QA-1 {MOIST FAULT}	DISCRETE	INPUT	Pump Motor Seal FAULT, Pump No. 1		
10A-TAH-1 {MTR TEMP}	DISCRETE	INPUT	Pump Motor Temperature HIGH, Pump No. 1		
10A-HS-1 {RUN}	DISCRETE	OUTPUT	Pump System RUN Command, Pump No. 1		
10A-QS-1 {RUN}	DISCRETE	INPUT	Pump System RUN Status, Pump No. 1		
10A-QS-1 {REMOTE}	DISCRETE	INPUT	Pump System In REMOTE Control Mode, Pump No. 1		
10A-QA-1 {MOIST FAULT}	DISCRETE	OUTPUT	Pump Motor Seal FAULT, Pump No. 1		
10A-TAH-1 {MTR TEMP}	DISCRETE	OUTPUT	Pump Motor Temperature HIGH, Pump No. 1		

Tag Number	Type	I/O	Description	PLC Register	Notes
10A-HS-1 {RUN}	DISCRETE	OUTPUT	Pump System RUN Command, Pump No. 1		
10A-QS-1 {RUN}	DISCRETE	INPUT	Pump System RUN Status, Pump No. 1		
10A-QS-1 {REMOTE}	DISCRETE	OUTPUT	Pump System in REMOTE Control Mode,		
10A-QA-2 {MOIST FAULT}	DISCRETE	INPUT	Pump Motor Seal FAULT, Pump No. 2		
10A-TAH-2 {MTR TEMP}	DISCRETE	INPUT	Pump Motor Temperature HIGH, Pump No. 2		
10A-HS-2 {RUN}	DISCRETE	OUTPUT	Pump System RUN Command, Pump No. 2		
10A-QS-2 {RUN}	DISCRETE	INPUT	Pump System RUN Status, Pump No. 2		
10A-QS-2 {REMOTE}	DISCRETE	INPUT	Pump System In REMOTE Control Mode, Pump No. 2		
10A-QA-2 {MOIST FAULT}	DISCRETE	OUTPUT	Pump Motor Seal FAULT, Pump No. 2		
10A-TAH-2 {MTR TEMP}	DISCRETE	OUTPUT	Pump Motor Temperature HIGH, Pump No. 2		
10A-HS-2 {RUN}	DISCRETE	OUTPUT	Pump System RUN Command, Pump No. 2		
10A-QS-2 {RUN}	DISCRETE	OUTPUT	Pump System RUN Status, Pump No. 2		
10A-QS-2 {REMOTE}	DISCRETE	OUTPUT	Pump System In REMOTE Control Mode, Pump No. 2		
10A-HS-1 {RESET}	DISCRETE	INPUT	Alarm RESET		

Tag Number	Type	I/O	Description	PLC Register	Notes
10A-QA-1 {POWER}	DISCRETE	INPUT	Loss Of Control Power		

3.9.4 Component Specifications

A. L5 Level Element and Transmitter, Ultrasonic:

1. General:

a. Function: Provide continuous non-contacting level measurement with output proportional to level being sensed.
b. Type: Ultrasonic.
c. Parts: Integral level element and transmitter.

2. Service:

a. Medium: Liquids.
b. Pressure: 7.25 psig maximum.
c. Temperature Range: Operating within a range of minus 40 to 176 degrees F.

3. Performance:

a. Range: As noted.
b. Zero Reference: As noted.
c. Sonic Frequency: 54 Hz.
d. Accuracy: Plus or minus the greater of 0.15 percent of range or 0.24-inches.
e. Resolution: Less than 3 mm.
f. Repeatability: Less than 3 mm.
g. Blanking Distance: 10-inches.
h. Update time: less than 5 seconds.

4. Features:

a. Display: Integral, multi-segment display providing the following:
(1) Programmable primary variable:
(a) Alphanumeric.
(b) Multi-segment bar graph.
(2) Primary variable engineering units.
(3) Sonic echo status.
(4) Programmable auxiliary variable with engineering units. Must support signal current at a minimum.
b. Process Connections: As noted.
c. Materials of Construction:
(1) Probe Head: Polybutylene Terephthalate (PBT).
(2) Probe Element: As noted.
d. Environmental Rating: NEMA 4/4x.

5. Signal Interface:

a. Output: 4- to 20-mA dc signal for load impedance 0 to 500 ohm minimum for 24V dc supply without load adjustments.
b. Digital process variable signal superimposed on 4- to 20-mA signal; using HART ® protocol.

6. Manufacturers:

a. Siemens; SITRAN Probe LU.
b. Or Equal.

B. L8 Level Switch, Float:

1. General:

a. Function: Actuate contact at preset liquid level.
b. Type: Direct-acting mercury free float with integral cable.

2. Service:

a. Liquid: Water, wastewater, unless otherwise noted.
b. Pressure: Atmospheric.
c. Temperature: 0 to 50 degrees C.

3. Performance:

a. Set Point: As noted.
b. Differential: 1-inch maximum.
c. Temperature: 0 to 180 degrees F.

4. Features:

a. Entire Assembly: Watertight and impact-resistant.
b. Float Material and Size: Polyethylene/foam filled; 4.5-inch diameter tear drop.
c. Cable:
(1) Combination support and signal.
(2) Length as noted or as necessary per mounting requirements.
(3) Type SO nitrile PVC jacket, AWG No. 18/2 or No. 18/4.
d. Mounting: Pipe (or) suspended as noted.
e. Pipe:
(1) Cable-to-pipe clamp, corrosion-proof cable for 1-inch pipe.
(2) Pipe-to-wall bracket for 1-inch pipe.

5. Signal Interface:

a. Switch Type: Mercury tilt.
b. Switch Contacts:
(1) Isolated, rated 4.5 continuous at 120V ac.
(2) As required (for example 1NO, 1NO=1NC) to meet functional requirements, or as shown.

6. Manufacturers and Products:

a. Consolidated Electric Co., Model LS.
b. Anchor Scientific: Toto-Float, Type P/Type S.

C. Y-55 PROGRAMMABLE LOGIC CONTROLLER (PLC)

1. General:

a. Function: Processor with communication ports.
b. Type: Capable of initiating communication
c. Parts: Processor, power supply, battery, I/O chassis, I/O modules and cabling.

2. Processor Features:

a. Central Processing Unit (CPU): Processor: 16 bit, minimum
b. Memory:
(1) User Logic: 16 K words
(2) Data: 24 Kbytes
c. Scan Time: Less than 1 msec per 1000 words

3. Communication:

a. Ports:
(1) One (1) RJ-45
(2) One (1) RS-232
b. Protocols
(1) Ethernet
(2) Data Highway (DH-485), DF1, ASCII

4. Diagnostics:

a. As a minimum, the CPU shall monitor the following system failures:
(1) Memory Failure
(2) Input/Output subsystem error
(3) Watchdog timer time out.
(4) Upon failure detection, the CPU shall provide a discrete output.

5. Programming:

a. Programming Language: Ladder Logic
b. Minimum Basic Operations:
(1) Binary logic operation
(2) Timers and counters
(3) Shift registers
(4) Drum sequencers
(5) Enhanced Operations:
(6) Four-function integer math
(7) Word shift registers
(8) Word compare
(9) Word move
(10) Two (2) PID controllers, as a minimum

6. Data Input/Output:

a. Discrete Input:
(1) Quantity: 16 Inputs
(2) Type: Vdc, sinking
(3) Nominal Operating Voltage: 48 Vdc
(4) Status Indication: LED

b. Discrete Output:
(1) Quantity: 8 Outputs
(2) Type: Relay, rated 8.0 amperes continuous at 120V ac.
(3) Nominal Operating Voltage: 24V dc
(4) Status Indication: LED

c. Analog Input, Differential:
(1) Signal Quantity: 8 Inputs
(2) Type: 4 -20 mA
(3) Isolation:
Between Channels: 200 V dc for 1 minute
Between Channel and Ground: 1780V ac for 1 minute
Resolution: 12 bit, minimum
(4) Status Indication: LED

d. Analog Output, Differential:
(1) Signal Quantity: 4 Outputs
(2) Type: 4 -20 mA
(3) Isolation:
Between Channels: 200 V dc for 1 minute
Between Channel and Ground: 1780V ac for 1 minute
Resolution: 12 bit, minimum
(4) Status Indication: LED

7. Environmental Requirements:

a. Mount each PLC, its power supply, and I/O modules inside the specified control panels or as shown on the Drawings.
b. General Specifications
(1) Operating Temperature: 0 to 45 degrees C
(2) Humidity: 5 to 95 percent, non-condensing

8. Power Supply: PLC equipment shall operate on 120V ac, plus or minus 10 percent, single phase, 60-Hz, plus or minus 0.5-Hz power.

9. Manufacturer and Product:

a. Allen Bradley SLC 5/05 Processor with Series 1746 I/O System.
b. Or Equal.

D. Y63 Operator Interface Unit:

1. General:

a. Function: Operator interface to PLC.
b. Type: Touchscreen.

2. Environmental:

a. Operating Temperature: 14 to 113 degrees F.
b. Humidity Rating: 10 to 90 percent, non-condensing.

3. Performance:

a. Enclosure:
(1) Size: 7.88 inches wide by 5.7 inches tall, nominally.
(2) Rating: NEMA 4.

b. Display:
(1) Type: 800 x 480 pixel High Definition TFT.
(2) Size: 6.1 inches wide by 3.4 inches tall, nominally.
(3) Backlight: LED; 30,000 hour life minimum.

(4) Brightness: 375 cd/m^2, minimum.
(5) Contrast: 500:1, minimum.
(6) Application Memory: 128 Mbyte Flash, minimum.

c. Touchscreen:
(1) Type: 4-wire, analog.
(2) Resolution: Continuous.

d. Features: Real Time Clock.

e. External Interface:
(1) Communication Ports:
(a) Network Port: RJ-45 EtherNet.
(b) Serial Port 1: RS 232 or RS 485 (DB9S).
(c) Serial Port 2: RS 232 (DB9P).
(d) Serial Port 3: USB.
(2) Communication Rates: 9600 baud, 19.2 kbaud, 38.4 kbaud, 57.6 kbaud, 115.2 kbaud.

f. Electrical Requirements: 24 VDC.

g. Accessories: Configuration software, MS Window compatible.

h. Manufacturer and Model:
(1) Maple Systems, HMI5070TH.
(2) Or approved equal.

-- End of Section --