National Aeronautics and
Space Administration
Armstrong Flight Research Center
P.O. Box 273
Edwards, CA 93523-0273

September 18, 2014

Subject: Project Approval Signatures:
FY15 CoF Repair B4824 Electrical

Chief, Facility Engineering & Asset Management Office	10-16-14 Date
Project Requestor/Customer	9/25/14 Date
Facilities Project Manager	9/18/14 Date
Chief, Office of Protective Services	9/19/14 Date
Chief, Safety, Health & Environmental Office	9/19/14 Date
DFRC Chief Information Officer	19 Sep 14 Date

SPECIFICATIONS

FINAL SUBMITTAL FOR:

NASA AFRC
REPAIR B4824 ELECTRICAL
DISTRIBUTION SYSTEM

Edwards Air Force Base, CA

September 9, 2014

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SECTION 00 01 15

LIST OF DRAWINGS
02/11

PART 1 GENERAL

1.1 SUMMARY

This section lists the drawings for the project. Electronic Drawing Management number for this project is EDM-1727.

1.2 CONTRACT DRAWINGS

Contract drawings are as follows:

DRAWING NO.	SHEET TITLE
T1	Title and Index Sheet
T2	General Notes
C1	Civil Legend, Notes, and Abbreviations
C2	Civil Site Plan
C3	Civil Details
A1	Site Plan
E1	Electrical Symbols, Notes, and Abbreviations
E2	Building 4824 Remodel Plan
E3	Partial Electrical Site Plan
E4	Building 4824 Remodel Plan
E5	Building 4824 Remodel Single Line Diagram
E6	Building 4824 Panel Schedules
E7	Panel Schedules
E8	Controls
E9	Electrical Details

-- End of Document --

SECTION 01 11 00

SUMMARY OF WORK
01/08

PART 1 GENERAL

1.1 SUMMARY

The work to be performed under this project consists of providing the labor, equipment, and materials to perform Repair B4824 Electrical Distribution System for the National Aeronautics and Space Administration at the Armstrong Flight Research Center (NASA/AFRC), Edwards, California 93523.

a. The civil work includes installing new concrete equipment pads at Building 4824. Existing asphalt pavement will be sawcut and demolished to make way for the new concrete pads. New guard posts will be installed to protect the equipment pads and the existing fuel pad.

b. The structural scope includes design and installation of the anchorage for new equipment to new concrete pads.

c. The architectural scope includes design and installation of an enclosure for electrical equipment to be constructed near the existing building.

d. The electrical scope includes (a) Upgrading the existing electrical equipment at B4824. The building interior circuit breaker panels, uninterruptible power supplies (UPS), and transformers will be replaced. (b) New UPS systems will be provided in an exterior enclosure, air conditioned for operation of electronic equipment. New UPS distribution system to new rack receptacles will be installed per NASA specifications. UPS battery cell monitoring system sensors and communications cable raceway provisions will be provided for voltage supervision at a designated B4824 workstation. (d) Existing exterior building electrical service equipment to be demolished, including switchboard, transformer, standby generator, load bank, and fuel tank. (e) Exterior building electrical service and distribution equipment to be installed per NASA specification to incorporate PLC controlled double ended switchboard with manual transfer switch interface for connecting a new portable standby generator.

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.

ASTM INTERNATIONAL (ASTM)

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

1.3 DEFINITIONS

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

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

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

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

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

1.4 CONTRACT DRAWINGS

Drawings and documents that accompany this specification are a part thereof, and are listed in section 00 01 15 List of Drawings.

Digital drawings and specifications will be furnished to the Contractor without charge. Reference publications will not be furnished. The Contractor shall immediately check furnished drawings and notify the Government of any discrepancies.

1.5 CONSTRUCTION SCHEDULE

Within the overall project schedule of 245 days, including the base bid and all options, the Contractor shall commence and complete the work.

The following reflects the number of calendar days that will be allowed for construction.

Task	Calendar Days
NTP-Mobilize Site	45
Construction (No Phases)	200
Etc.	
Total	245

(*must equal first sentence in this subpart.*)

1.6 WORK HOURS

All Construction work under this contract shall be performed during normal duty hours. Normal duty hours are defined in Section 01 14 00 "WORK RESTRICTIONS". Weekends and Government holidays may be restricted for work unless otherwise directed by Contracting Officer.

The Contractor shall allow for a maximum of ten (10) days per year where

construction activity is not permitted because NASA facilities are closed.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 14 00

WORK RESTRICTIONS
07/07

PART 1 GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contact List of Key Personnel; G

1.2 CONTRACTOR ACCESS AND USE OF PREMISES

1.2.1 Activity Regulations

Contractor personnel employed on the Activity shall become familiar with and obey Activity regulations including safety, fire, traffic and security regulations according to Section 01 35 14.11 40 "AFRC Safety Requirements." Contractor personnel shall keep within the limits of the work and avenues of ingress and egress. To minimize traffic congestion, delivery of materials shall be outside of peak traffic hours (Peak traffic hours are 6:30 to 8:00 a.m. and 3:30 to 5:00 p.m.) unless otherwise approved by the Contracting Officer. Contractor personnel shall not enter any restricted areas unless required to do so and until cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification.

1.2.1.1 MATERIAL AND EQUIPMENT

Shipments shall be addressed to the Contractor who shall be responsible for their receipt, unloading, handling, and storage at the site. The Government will not accept deliveries on behalf of the Contractor or Subcontractors or assume responsibility for security of materials, equipment, or supplies delivered to the site. The Contractor shall not have any material or equipment deliveries made to the AFRC shipping and receiving warehouse. The Contractor shall use the following address:

(Name of Contractor's firm or company)
P.O.C. (Name of Contractor's superintendent or other employee)FY15
Repair Communications Building Electrical Systems
NASA Armstrong Flight Research Center
Edwards, CA 93524

The Contractor shall protect and preserve materials, supplies, and equipment of every description, including property which may be Government-furnished or Government-owned. Material to be salvaged and reinstalled by the Contractor shall be protected during removal and stored to prevent damage. Only material and construction equipment designated for performance of contract work may be stored at the construction site or located in Government-controlled areas.

Materials and equipment to be provided under this contract shall be standard catalogue products of manufacturers regularly engaged in the

manufacture of the products. Material and equipment shall be installed in accordance with the requirements of the contract drawings and approved recommendations of the manufacturers.

1.2.1.2 Subcontractors and Personnel Contacts

Contractor shall furnish a contact list of key personnel including e-mail addresses and telephone numbers. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.2.1.3 Identification Badges

Identification badges will be furnished without charge. Application for and use of badges will be as directed. Contractor shall submit for approval on NASA Form DFRC-735 or DFRC-736, at least 15 days prior to the desired date of entry, a list of personnel who require entry into Government property to perform work on the project. Furnish a completed EMPLOYMENT ELIGIBILITY VERIFICATION (DHS FORM I-9) form for all personnel requesting badges. This form is available at http://www.uscis.gov/sites/default/files/files/form/i-9.pdf. Immediately report instances of lost or stolen badges to the Contracting Officer.

1.2.1.4 Personnel Entry Approval

Failure to obtain entry approval will not affect the contract price or time of completion.

1.2.1.5 No Smoking Policy

Smoking is prohibited within and outside of all buildings on installations under the cognizance of NASA except in designated smoking areas. This applies to existing buildings, buildings under construction and buildings under renovation. Discarding tobacco materials other than into designated tobacco receptacles is considered littering and is subject to fines. The Contracting Officer will identify designated smoking areas.

1.2.2 NORMAL DUTY HOURS

Normal duty hours are from 6:00 am to 5:30 pm Monday through Friday the first week, and then from 6:00 am to 5:30 pm Monday through Thursday the second week, excluding federal holidays. Armstrong Flight Research Center is currently operating under this flexible work schedule, permitting employees to work 80 hours in 9 days (known as a 9/80 schedule) and have a nonwork day every other Friday. The Center is closed every other Friday. The contractor's work shifts shall take place as described in Section 01 11 00, except as requested and approved per paragraph "Work Outside Normal Duty Hours" below.

1.2.2.1 Work Outside Normal Duty Hours

Work outside normal duty hours requires Contracting Officer approval. Make application 14 calendar days prior to such work to allow arrangements to be made by the Government for inspecting the work in progress, giving the specific dates, hours, location, type of work to be performed, contract number and project title. Based on the justification provided, the Contracting Officer may approve work outside normal duty hours. During periods of darkness, the different parts of the work shall be lighted in a manner approved by the Contracting Officer.

1.2.3 OCCUPANCY OF PREMISES DURING CONSTRUCTION

The buildings will be occupied during performance of work under this Contract. Before work is started, the Contractor shall arrange with the Contracting Officer a sequence of procedure, means of access, space for storage of materials and equipment, and use of approaches, corridors, and stairways. Government personnel will be allowed in the construction area to perform routine or emergency maintenance on building systems and equipment. This includes communication, electrical, mechanical, and fire protection systems.

1.3 ENVIRONMENTAL CONSIDERATIONS

The Edwards AFB property, which NASA shares, is on the National Priorities List (NPL, or Superfund) due to known areas of soil and groundwater contamination. Known contamination in soil has been cleaned up, and known contamination in shallow groundwater is under treatment but not yet cleaned up. The Contractor shall be aware that all intrusive activities that require a dig permit (greater than 6" deep) may also require vapor monitoring and use of Personal Protective Equipment (PPE) when work is occurring within these areas, unless waived by the Contracting Officer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 20 00.00 20

PRICE AND PAYMENT PROCEDURES
02/10

PART 1 GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Schedule of Values; G

SD-11 Closeout Submittals

Contractor's Invoice shall be submitted in accordance with Paragraph "CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT"

1.2 SCHEDULE OF VALUES

1.2.1 Data Required

Within 15 calendar days after Notice of Award, the Contractor shall prepare and deliver to the Contracting Officer a schedule of values for approval. The Schedule of Values shall consist of a detailed breakdown of each contract activity. The value of each activity shall be identified as a percentage of the total contract value, and shall correlate with the activities in the Project Schedule.

Contracting Officer will determine whether items in the Schedule of Values are appropriate. Progress payments shall be based on the approved Schedule of Values.

1.2.2 Schedule Instructions

Payments will not be made until the Schedule of Values has been submitted to and accepted by the Contracting Officer.

1.3 CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT

1.3.1 Content of Invoice

Requests for payment will be processed in accordance with the Contract Clause FAR 52.232-27. Invoices not completed in accordance with contract requirements will be returned to the Contractor for correction of the deficiencies. Requests for payment in accordance with the terms of the contract shall consist of:

a. The Contractor's invoice on the form furnished by the Contracting Officer for this purpose, shall show in summary form the basis for arriving at the amount of the invoice.

b. The contract performance statement on the form furnished by the Contractor for this purpose and consistent with the approved Schedule of Values, shall show in detail the estimated percentage of completion

for each Definable Feature of Work (DFOW). The format, content, and number of copies required will be prescribed by the Contracting Officer and will be subject to his/her approval.

c. Furnish a certificate to the CO with each payment request attesting that the work for which payment is requested, including stored material, is in compliance with contract requirements.

d. The Estimate for Voucher, showing in detail the percentage of completion for each of the construction activities listed on the Schedule of Values.

e. Updated Project Schedule and any reports required by the contract.

g. Contractor Safety Self-Evaluation Checklist

h. Weekly Certified Payroll Report

i. Solid Waste Disposal Report

j. Other supporting documents as requested

k. For Final Payment: All closeout submittals must be received prior to final payment. A final invoice and the Contractor's Final Release is the Contractor's request for final payment, including completed As-Built Drawings. If the Contractor is incorporated, the Final Release shall contain the corporate seal. An officer of the corporation shall sign and the corporate secretary or official designee shall certify the Final Release.

No separate payments will be made for protection efforts necessitated by the safety provisions.

1.4 PAYMENTS TO THE CONTRACTOR

Payments will be made on submission of itemized requests by the Contractor will be subject to reduction for overpayments or increase for underpayments made on previous payments to the Contractor.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS
02/10

PART 1 GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Electronic Mail (E-Mail) Address; G

View location map; G

Progress and completion pictures; G

SD-04 Samples

Color boards; G

1.2 COLOR BOARDS

Submit five sets of color boards within 90 calendar days after Contract Award. Each set of boards shall include samples of colors and finishes of interior surfaces, such as walls, floors, and ceilings. The samples shall be presented on 8 by 10-1/2 inches boards (modules) with a maximum spread of 24 by 31-1/2 inches for foldouts. Modules shall be designed to fit in a standard loose-leaf, three-ring binder. Where special finishes such as architectural concrete, carpet, or prefinished textured metal panels are required, samples not less than 12 inches square shall be submitted with the board. If more space is needed, more than one board per set may be submitted. The Contractor shall certify that he has reviewed the color samples in detail and that the color samples are in strict accordance with contract drawings and specifications, except as may be otherwise explicitly stated. Submittal of color samples shall not relieve the Contractor of the responsibility to submit samples required elsewhere herein.

1.3 VIEW LOCATION MAP

Submit to the Contracting Officer, prior to or with the first digital photograph submittals, a sketch or drawing indicating the required photographic locations. Update as required if the locations are moved.

1.4 PROGRESS AND COMPLETION PICTURES

Photographically document site conditions prior to start of construction operations. Provide monthly, and within one month of the completion of work, digital photographs, 1600x1200x24 bit true color minimum resolution in JPEG file format showing the sequence and progress of work. Take regular digital photographs throughout the entire project from a minimum of ten views from points located by the Contracting Officer. Submit with the monthly invoice one set of digital photographs on a CD-R, cumulative of all photos to date. Indicate photographs demonstrating environmental procedures. Photographs for each month shall be in a separate monthly

directory and each file shall be named to indicate its location on the view location sketch. The view location sketch shall also be provided on the CD as digital file. All file names shall include a date designator. Cross reference submittals in the appropriate daily report. Photographs shall be provided for unrestricted use by the Government.

1.5 SUPERVISION

Provide at least one (1) qualified Project Manager and one (1) qualified on-site Project Superintendent. The Project Manager must have a minimum of 10 years experience as a Project Manager or Superintendent on projects like this contract or similar in size and complexity. The Project Superintendent must have a minimum of 10 years' experience as a Superintendent on projects similar in size and complexity.

In addition to the above experience requirements, the Project Manager and on-site Project Superintendent shall complete the U.S. Army Corps of Engineers course entitled "Construction Quality Management for Contractors" prior to the start of construction.

The Project Manager in this context shall mean the individual with the responsibility for the overall management of the project and the Project Superintendent shall mean the individual with the responsibility for production. Both the Project Manager and Project Superintendent are subject to removal by the Contracting Officer for non-compliance with requirements specified in the contract and for failure to manage the project to ensure timely completion. Furthermore, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time for excess costs or damages by the Contractor.

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

1.6 PROJECT MEETINGS

1.6.1 Preconstruction Conference

The Contractor shall attend a preconstruction conference scheduled by the Contracting Officer. Work shall not commence prior to the conference. Discussion shall address project orientation, personnel contact, safety issues, permits, deficiencies, quality control and the location of the Contractor's office.

1.6.2 Weekly Project Meetings

The Contractor shall attend weekly project meetings scheduled by the Government. Discussion shall address at a minimum: safety issues, quality control, submittals, progress schedule, schedule of submittals, as-built drawings, deficiencies, material delivery, permits, equipment delivery, invoices, potential factors of delay, request for information (RFIs), changes, and functional tests.

1.7 PARTNERING

To most effectively accomplish this contract, the Government requires the formation of a cohesive partnership within the Project Team whose members are from the Government, the Contractor and their Subcontractors. Key personnel from NASA, the Contractor and Subcontractors, and the Designer of Record will be invited to participate in the Partnering process. The Partnership will draw on the strength of each organization in an effort to achieve a project that is without any safety mishaps, conforms to the Contract, and stays within budget and on schedule.

The Contracting Officer will provide Information on the Partnering Process and a list of key and optional personnel who should attend the Partnering meeting.

1.7.1 Formal Partnering

Provide and host the Partnering sessions with key personnel of the Project Team, including Contractor personnel and Government personnel. Pay all costs associated with the Partnering effort including the Facilitator, the meeting room, and other incidental items. In exception, participants shall bear their own costs for meals, lodging, and transportation associated with the Partnering sessions.

Before a Partnering session, coordinate with the Facilitator all requirements for incidental items (such as audio-visual equipment, easels, flipchart paper, colored markers, note paper, pens/pencils, colored flash cards, etc.), and have these items available at the Partnering session. Provide copies of documents for distribution to all attendees.

The Facilitator shall be experienced in conducting Partnering Workshops, and shall be acceptable to both the Government and the Contractor. The Facilitator is responsible for leading the team in a timely manner and making sure that issues are identified and resolved. A list of Partnering Facilitators is available from the Contracting Officer.

a. The Initial Partnering Session shall be a duration of one day minimum. It shall be located at a place off the construction site, as agreed to by the Contracting Officer and the Contractor. It may take place concurrently with the Pre-Construction Meeting.

b. The Follow-on Partnering Session(s) generally last a half day or less. Schedule them at 3 to six month intervals, or when needed. Participants are encouraged to utilize electronic means to expedite meetings. Meetings may be held at a location off-Base, at the project site, or in a Government Facility on Base. Follow-on meetings may be held concurrently with other scheduled meetings. Attendees need only be those required to resolve current issues. Recommend using the same Facilitator from the Initial Partnering session to achieve best results and for continuity.

1.7.2 Informal Partnering

The Contracting Officer will organize the Partnering Sessions with key personnel of the project team, including Contractor personnel and Government personnel.

The Initial Partnering session should be a part of the Pre-Construction Meeting. Partnering sessions will be held at a location agreed to by the

Contracting Officer and the Contractor (typically a conference room provided by NASA or the Contractor).

The Partners will determine the frequency of the follow-on sessions.

1.8 ELECTRONIC MAIL (E-MAIL) ADDRESS

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

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

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 32 01.00 10

PROJECT SCHEDULE
08/08

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)

ECB 2005-10	(2005) Scheduling Requirements for Testing of Mechanical Systems in Construction Contracts

1.2 SUBMITTALS

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

SD-01 Preconstruction Submittals

Project Schedule; G

1.3 QUALIFICATIONS OF PROJECT SCHEDULER

Designate an authorized representative to be responsible for the preparation of the schedule and all required updating (activity status) and preparation of reports. The authorized representative shall be experienced in scheduling projects similar in nature and complexity to this project and shall be experienced in the use of the scheduling software that meets the requirements of this specification.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

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

3.1.1 Approved Project Schedule

Use the approved Project Schedule to measure the progress of the work and to aid in evaluating time extensions. The schedule shall be cost loaded and activity coded. The schedule will provide the basis for all progress payments. The project schedule shall be capable of showing percent complete for each activity.

3.1.2 Schedule Status Reports

Provide a Schedule Status Report on at least a monthly basis. If the Contracting Officer determines that the Contractor has fallen behind the approved schedule, the Contracting Officer may require the Contractor to take steps necessary to improve its progress without additional cost to the Government.

3.2 PROJECT SCHEDULE DETAILED REQUIREMENTS

The computer software system utilized to produce and update the Project Schedule shall be capable of meeting all requirements of this specification.

3.2.1 Level of Detail Required

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

3.2.1.1 PROGRESS SCHEDULE REQUIREMENTS

The Contractor shall prepare and submit to the Contracting Officer for approval a practicable schedule showing the order in which the Contractor proposes to perform the work, and the dates on which the Contractor contemplates starting and completing the major salient features of the work, including acquiring materials and equipment. The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period. The Contractor shall:

a. Submit the progress chart in one reproducible format and three copies to the Contracting Officer for approval no later than 15 days after notice to proceed.

b. Prepare the progress chart in the form of a bar chart utilizing a form "Construction Progress Chart" or comparable format acceptable to the Contracting Officer.

c. Include no less than the following information on the progress chart:

1. Break out by major headings for each primary work activity.

2. A line item break-out under each major heading sufficient to track the progress of the work.

3. A line item showing contract finalization tasks which include punch list, clean-up, O&M data, and As-Built drawings. These activities are to show no associated costs.

4. The estimated percentage weight of total contract value for each line item on the chart. This shall be consistent with the Schedule of Values.

5. Separate line items for submittal preparation and reviews. These shall be consistent with the "Schedule of Submittals" required in Section 01 45 00.10 40, "CONTRACTOR QUALITY CONTROL". Submittal preparation and reviews are to show no associated costs.

6. Separate line items for mobilization and demobilization.

d. Update the progress schedule in 3 copies every 30 days throughout the contract performance period. The updated schedule shall be submitted with the monthly payment request.

3.2.1.2 Activity Durations

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

3.2.1.3 Procurement Activities

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

3.2.1.4 Mandatory Tasks

The following tasks must be included and properly scheduled if in scope:

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

c. Submission and approval of O & M manuals.

d. Submission and approval of as-built drawings.

e. Submission and approval of NASA Form NF1046 "Transfer and/or Notification of Acceptance of Accountability of Real Property" data.

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

g. Submission of TAB specialist design review report.

h. Submission and approval of fire protection specialist.

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

j. Air and water balancing.

k. HVAC commissioning.

l. Controls testing plan submission.

m. Controls testing.

n. Performance Verification testing.

o. Other systems testing, if required.

p. Submission and approval of installed equipment lists.

q. Final inspection.

3.2.1.5 Government Activities

Show Government and other agency activities that could impact progress. These activities include, but are not limited to: approvals, inspections, utility tie-in, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements.

3.2.2 Scheduled Project Completion and Activity Calendars

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

3.2.2.1 Project Start Date

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

3.2.2.2 Schedule Constraints and Open Ended Logic

Constrain completion of the last activity in the schedule by the contract completion date. Schedule calculations shall result in a negative float when the calculated early finish date of the last activity is later than the contract completion date. Include as the last activity in the project schedule an activity called "End Project" with an end date equal to the contract completion date for the project, and with a zero day duration. The schedule shall have no constrained dates other than those specified in the contract.

3.2.2.3 Early Project Completion

In the event the Initial project schedule calculates an early completion date of the last activity prior to the contract completion date, identify those activities that it intends to accelerate and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. The last activity shall have a late finish constraint equal to the contract completion date and the schedule will calculate positive float. The Government is under no obligation to accelerate activities for which it is responsible to support a proposed early contract completion.

3.2.3 Milestones

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

3.3 PROJECT SCHEDULE SUBMISSIONS

Provide the submissions as described below. The data Compact Disk (CD), reports, and schedules required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

3.3.1 Initial Project Schedule Submission

Submit the Initial Project Schedule for approval within 5 calendar days after NTP. The schedule shall demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. The Initial Schedule shall be at a reasonable level of detail as determined by the Contracting Officer.

3.3.2 Periodic Schedule Updates

Based on the result of the meeting, specified in PERIODIC SCHEDULE UPDATE MEETINGS, submit periodic schedule updates. These submissions will enable the Contracting Officer to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgment of the Contracting Officer or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.

3.3.3 [Phased]Construction Schedule

Include in Project Schedule submissions, and update submissions, all Construction[Phase] Scheduling as required in 01 11 00 SUMMARY OF WORK. Include Contractor's plan to address any issues that put the schedule at risk.

3.4 SUBMISSION REQUIREMENTS

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

3.4.1 Data Delivery

Provide digital files containing the project schedule in the original scheduling software format, and PDF format. Each delivery shall also contain all previous update schedules. File medium shall be CD or other digital media approved by Contracting Officer. Label each CD indicating the type of schedule (Initial or Periodic Update), full contract number, Data Date and project title. Each schedule shall have a unique file name as determined by the Contractor.

3.4.2 Narrative Report

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

3.4.3 Approved Changes Verification

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

3.4.4 Schedule Reports

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

3.4.4.1 Activity Report

A list of all activities sorted according to activity number.

3.4.4.2 Logic Report

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

3.4.4.3 Total Float Report

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

3.4.4.4 Earnings Report by Activity

A compilation of the Contractor's Total Earnings on the project from the NTP to the data date. This report shall reflect the earnings of specific activities based on the agreements made in the schedule update meeting defined herein. Provided that the Contractor has furnished a complete schedule update, this report shall serve as the basis of determining progress payments. Group activities by activity number. This report shall: sum all activities and provide a percent complete. The printed report shall contain, for each activity: the Activity Number, Activity Description, and Percent Complete (based on total contract value).

3.4.5 Network Diagram

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

3.4.5.1 Continuous Flow

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

3.4.5.2 Project Milestone Dates

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

3.4.5.3 Critical Path

Clearly show the critical path.

3.4.5.4 Banding

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

3.5 PERIODIC SCHEDULE UPDATE MEETINGS

Conduct periodic schedule update meetings for the purposes of reviewing the Contractor's proposed out of sequence corrections, determining causes for delay, correcting logic, maintaining schedule accuracy and determining percent complete. Meetings shall occur at least monthly within five days of the proposed schedule data date and after the Contractor has updated the schedule with Government concurrence respecting actual start dates, actual finish dates, remaining durations and percent complete for each activity it intends to status. Provide a computer with the scheduling software loaded and a projector during the meeting which allows all meeting participants to view the proposed schedule update during the meeting.

3.5.1 Update Submission Following Progress Meeting

Submit a complete update of the project schedule containing all approved progress, revisions, and adjustments, pursuant to paragraph SUBMISSION

REQUIREMENTS not later than 4 working days after the periodic schedule update meeting, reflecting only those changes made during the previous update meeting.

3.5.2 Status of Activities

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

3.5.2.1 Start and Finish Dates

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

3.5.2.2 Remaining Duration

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

3.5.2.3 Percent Complete

Update the percent complete for each activity started, based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete. To allow for proper schedule management, cost load the correction of punch list from Government final inspection not less than 1 percent of the total contract value, which activity(ies) may be declared 100 percent complete upon completion and correction of all punch list work identified during Government final inspection.

3.6 WEEKLY PROGRESS MEETINGS

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

b. Provide a bar chart showing Total Float and Sorted by Early Start Date, with a two week "look-ahead" schedule by filtering all schedule activities to show only current ongoing activities and activities schedule to start during the upcoming two weeks, organized by

responsible party and sorted by Early Start Date.

c. The Government and the Contractor shall jointly review the reports. If it appears that activities on the longest path(s) which are currently driving the calculated completion date, are not progressing satisfactorily and therefore could jeopardize timely project completion, corrective action must be taken immediately.

3.7 OWNERSHIP OF FLOAT

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

-- End of Section --

SECTION 01 33 00

SUBMITTAL PROCEDURES
06/10

PART 1 GENERAL

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 the start of construction work on-site, such as:

List of proposed products

Construction Progress Schedule

Network Analysis Schedule (NAS)

Submittal register

Schedule of Values

Accident Prevention Plan

Activity Hazard Analysis for Mobilization

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 un-fabricated 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 accordance with specified requirements.

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.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and Safety Data Sheet (SDS) 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.

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 operate and maintain 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, database, 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, warranty certificates, training records, asset / equipment list with cost breakdown, 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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor QC approval. Submit the following in accordance with this section.

SD-01 Preconstruction Submittals

Updated Submittal Register; G

1.3 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.3.1 Contractor QC Approved (Submittals without a "G" designation)

Contractor shall review all construction submittals for quality control. When Government approval is not required, Contractor shall be held responsible for submittal approval and construction per contract documents.

1.3.2 Government Approved (Submittals with a "G" designation)

Government approval is required for 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.

1.4 PREPARATION

1.4.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels to the Contracting Officer. 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," of this section.

1.4.2 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 and applicable drawing numbers 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.

1.4.2.1 Digital Submittals

In addition to providing the required quantity of hard copies of administrative, informational, material, O&M, and as-built drawing submittals, the contractor shall also include one electronic copy of each submittal. The electronic copy shall be in both an original editable file format (when created by the Contractor) and PDF format and submitted on non-rewritable optical media (CD or DVD) at the same time as the hard copy submittal. If material is copyrighted, written permission from the copyright holder for digital replication of O&M Manuals shall also be included. Red-lined as-built drawings shall be scanned to PDF in the same paper size as the original.

1.4.3 Format for SD-02 Shop Drawings

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.

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.

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

Number drawings in a logical sequence. 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.

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

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

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

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.

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

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

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

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

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

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.

Submit manufacturer's instructions prior to installation.

1.4.5 Format of SD-04 Samples

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

a. Sample of Equipment or Device: Full size.

b. Sample of Materials Less Than 2 by 3 inches: Built up to A4 8 1/2 by 11 inches.

c. Sample of Materials Exceeding A4 8 1/2 by 11 inches: Cut down to A4 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.

d. 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.

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

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

g. Sample Panel: 4 by 4 feet.

h. Sample Installation: 100 square feet.

Samples Showing Range of Variation: Where variations in color, finish, pattern, or texture are unavoidable due to nature of the materials, submit

sets of samples of not less than three units showing extremes and middle of range. Mark each unit to describe its relation to the range of the variation.

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

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

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

1.4.6 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.

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

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

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

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

Comply with the requirements as specified in each section.

1.4.9 Format of SD-11 As-Built Drawings

Comply with the requirements as specified in each section.

1.5 QUANTITY OF SUBMITTALS

1.5.1 Number of Copies of SD-02 Shop Drawings

Submit three (3) copies of submittals of shop drawings requiring review and approval by Contracting Officer.

1.5.2 Number of Copies of SD-03 Product Data and SD-08 Manufacturer's Instructions

Submit in compliance with quantity requirements specified for shop drawings.

1.5.3 Number of Samples SD-04 Samples

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

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

c. Submit one sample installation, where directed.

d. Submit one sample of non-solid materials, where directed.

1.5.4 Number of Copies SD-05 Design Data and SD-07 Certificates

Submit in compliance with quantity requirements specified for shop drawings.

1.5.5 Number of Copies SD-06 Test Reports and SD-09 Manufacturer's Field Reports

Submit in compliance with quantity and quality requirements specified for shop drawings other than field test results that will be submitted with QC reports.

1.5.6 Number of Copies of SD-10 Operation and Maintenance Data

Submit three copies of O&M Data to the Contracting Officer for review and approval.

1.5.7 Number of Copies of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

Unless otherwise specified, submit three sets of administrative submittals.

1.6 VARIATIONS

Variations from contract requirements require Government approval pursuant to contract Clause FAR 52.236-21 titled, "Specifications and Drawings for Construction," and will be considered where advantageous to the Government.

1.6.1 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).

1.6.2 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, including the written analysis. If lower cost is a benefit, Contractor shall 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. If submittal shows variations from the contract requirements, the Contractor shall include description of such variations, including notification of cost increase or decrease, in writing at the time of submission.

Contractor shall specifically point out variations from contract requirements in transmittal letters. Failure to obtain Contracting Officer approval for variations, and associated costs, prior to executing work may result in the Government rejecting executed work, and requiring removal and replacement at no additional cost to the Government per FAR 52.236-21.

1.6.3 Warranting That Variations Are Compatible

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

1.6.4 Review Schedule Is Modified

In addition to normal submittal review period, the Government will be allowed a period of 30 working days to consider submittals with variations.

1.7 UPDATED SUBMITTAL REGISTER

The Contractor shall prepare and maintain submittal register, as the work progresses. The submittal register must have the following columns, as a minimum:

Specification Section in which submittal is required.

Submittal Description (SD No. and type, e.g. SD-02 Shop Drawings) required in each specification section.

Principal Paragraph Number, in specification section where a material or product is specified.

Thereafter, the Contractor is to track all submittals by maintaining a complete list, including completion of all data columns, including dates on which submittals are received and returned by the Government.

1.7.1 Use of Submittal Register

Submit Submittal Register with QC plan and project schedule. Verify that all submittals required for project are listed and add missing submittals. Coordinate and complete the following fields on the registersubmitted with the QC plan and the project schedule:

Activity number from the project schedule.

Scheduled date for approving authority to receive submittals.

Date Contractor needs approval of submittal.

Date that Contractor needs material delivered to Contractor control.

1.8 SCHEDULING

Within 30 calendar days of notice to proceed, provide, for approval by the Contracting Officer, a schedule of all 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.

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay

damages or time extensions will be allowed for time lost in late submittals.

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

b. Submittals called for by the contract documents will be listed on the register.

c. Re-submit register and annotate monthly by the Contractor with actual submission and approval dates. When all items on the register have been fully approved, no further re-submittal is required.

d. Carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

1.9 GOVERNMENT APPROVING AUTHORITY

When the approving authority is the Contracting Officer, the Government will return submittals with review notations as described herein.

1.9.1 Review Notations

Contracting Officer review will be completed within 15 working days after date of submission. Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "approved" authorize the Contractor to proceed with the work covered.

b. Submittals marked "approved as noted" authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.

c. Submittals marked "return for correction" or "not approved," indicate noncompliance with the contract requirements or design concept, or the submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.

1.10 SUBMITTALS NOT APPROVED

The Contractor shall make corrections required by the Contracting Officer. 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 of submittals is not be construed as a complete check, and indicates only that:

Approval will not relieve the Contractor of the responsibility for any error which may exist. The Contractor shall fulfill Contractor Quality Control (CQC) requirements of this contract.

After submittals have been approved 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 shall assure that the materials or equipment will be available in quantities required in the project.

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, and 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. The Contractor shall replace such materials or equipment to meet contract requirements at no additional cost to the Government.

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

1.13 PROGRESS SCHEDULE

1.13.1 Bar Chart

a. Submit the progress chart, for approval by the Contracting Officer, at the Preconstruction Conference in one reproducible format and three (3) copies.

b. Submit the progress chart in one reproducible format and three (3) copies to the Contracting Officer for approval no later than 15 days after Notice to Proceed.

c. Prepare the progress chart in the form of a bar chart utilizing form "Construction Progress Chart" or comparable format acceptable to the Contracting Officer.

d. Include no less than the following information on the progress chart:

(1) Break out by major headings for each primary work activity.

(2) A line item break-out under each major heading sufficient to track the progress of the work.

(3) A line item showing contract finalization tasks, which include punch list, clean-up, O&M Data, demolition, and As-Built drawings. These activities are to show no associated costs.

(4) The estimated percentage weight of total contract value for each

line item on the chart. This shall be consistent with the Schedule of Values.

(5) Separate line items for submittal preparation and reviews. These shall be consistent with the "Schedule of Submittals" required in Section 01 45 00.10 40, "CONTRACTOR QUALITY CONTROL". These activities are to show no associated costs.

(6) Separate line items for mobilization and demobilization.

e. Update the progress schedule in one reproducible format and three (3) copies every 30 calendar days throughout the contract performance period. The updated schedule shall be submitted with the monthly payment request.

1.14 STATUS REPORT ON MATERIAL ORDERS

Within 30 calendar days after notice to proceed, the Contractor shall submit, for approval by the Contracting Officer, an initial material status report on all material orders. This report will be updated and re-submitted every 14 calendar days as the status on material orders changes.

Report to include list, in chronological order by need date, material 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 Definable Feature of Work (DFOW) 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

-- End of Section --

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		01 14 00	SD-01 Preconstruction Submittals															
			Contact List of Key Personnel	1.2.1.2	G													
		01 20 00.00 20	SD-01 Preconstruction Submittals															
			Schedule of Values	1.2	G													
			SD-11 Closeout Submittals															
			Contractor's Invoice	1.3														
		01 30 00	SD-01 Preconstruction Submittals															
			Electronic Mail (E-Mail) Address	1.8	G													
			View location map	1.3	G													
			Progress and completion pictures	1.4	G													
			SD-04 Samples															
			Color boards	1.2	G													
		01 32 01.00 10	SD-01 Preconstruction Submittals															
			Project Schedule	3.3	G													
		01 33 00	SD-01 Preconstruction Submittals															
			Updated Submittal Register	1.7	G													
		01 35 14.11 40	SD-01 Preconstruction Submittals															
			Contractor's Accident Prevention	1.8.1	G													
			Plan															
			Activity Hazard Analysis	1.9.1	G													
			Request for Excavation and	1.17.1	G													
			Digging Permit															
			Request for Confined Space	1.17.2	G													
			Entry Permit															
			Request for Utility Outage/Facility	1.17.3	G													
			Closure Permit															

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		01 35 14.11 40	Request for Crane Operation	1.17.4	G													
			Permit															
			Request for Open Flame and	1.17.5	G													
			Hotwork Permit															
			Request for Energized Electrical	1.17.6	G													
			Work Permit;															
			SD-06 Test Reports															
			Gas Protection	1.17.2.1														
			SD-07 Certificates															
			Contractor's Accident Prevention	1.8.1														
			Plan															
			Protection Plan	1.8.2														
			License Certificates	1.20														
			Safety Meeting/Safety Inspection	1.12.2														
			sheets															
			Safety Meeting Attendance	1.12.2														
			sheets															
			SD-08 Manufacturer’s Instructions															
			Safety Data Sheets	1.9.2	G													
		01 35 40.00 20	SD-01 Preconstruction Submittals															
			Environmental Protection Plan	1.8	G													
			Instructor Qualifications	1.9.1														
			SD-03 Product Data															
			Packaging	2.1.2														
			SD-06 Test Reports															
			Field Quality Control Reports	3.2														

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		01 35 40.00 20	SD-07 Certificates															
			Environmental Regulatory	1.6														
			Requirements															
			SD-08 Manufacturer’s Instructions															
			Safety Data Sheets	1.7.1														
			SD-11 Closeout Submittals															
			Training Program	1.9.3														
			Protection of Natural Resources	3.1														
			Contractor's NPDES/SWPPP	3.1.2														
		01 45 00.10 40	SD-01 Preconstruction Submittals															
			QC Plan	1.6	G													
		01 50 00	SD-01 Preconstruction Submittals															
			Construction site plan	1.4	G													
			Traffic control plan	3.3.1	G													
			SD-06 Test Reports															
			Backflow Preventer Tests	1.5.3														
			SD-07 Certificates															
			Backflow Tester	1.5.1														
			Backflow Preventers	1.5														
		01 74 19	SD-01 Preconstruction Submittals															
			Waste Management Plan	1.6	G													
			SD-11 Closeout Submittals															
			Records	1.7														
			Salvage Material Records	1.8														
		01 75 00.00 40	SD-01 Preconstruction Submittals															
			Verification of Prior Experience	1.2.1	G													

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		01 75 00.00 40	Documentation of Manufacturer's	1.2.1	G													
			Prior Experience															
			Quality Control Plan	1.2.1	G													
			Manufacturer's Sample Warranty	1.2.1														
			Operation and Maintenance Data	1.2.1	G													
			Operation and Maintenance Data	1.2.3	G													
			Provide Evidence	1.2.1														
			SD-02 Shop Drawings															
			Drawings, Diagrams and	1.2.2	G													
			Schedules															
			Diagrams and Instructions	1.2.2	G													
			Drawings	1.2.2	G													
			SD-03 Product Data															
			Catalog cuts	1.2.3	G													
			Samples of warranty language	1.2.3	G													
			SD-05 Design Data															
			Design Calculations	1.2.3	G													
			SD-06 Test Reports															
			Factory Tests	1.2.4.2	G													
			Functional Field Test	1.2.4.3	G													
			Final Acceptance Test	1.2.4.4	G													
			Test Procedures	1.2.4.5	G													
			SD-07 Certificates															
			Qualification of Manufacturer	1.2.1	G													
			Qualification of Installer	1.2.1														
			SD-08 Manufacturer’s Instructions															

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		01 75 00.00 40	Manufacturer's Administrative	1.2.1	G													
			Requirements															
			Demonstration and Training	1.2.1	G													
			Information															
			Manufacturer's Procedural	1.2.1	G													
			Requirements															
			SD-09 Manufacturer’s Field															
			Reports															
			Documentation of the Testing	1.2.4.3	G													
			and Verification Actions															
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance Data	1.2.1														
			Operation and Maintenance Data	1.2.3														
			Safety and Security Data or	1.2.3														
			Posters															
		01 78 00	SD-03 Product Data															
			As-Built Record of Equipment	1.3.2														
			and Materials															
			Warranty Management Plan	1.7.1														
			Warranty Tags	1.7.4														
			Final Cleaning	1.9														
			Spare Parts Data	1.4														
			SD-08 Manufacturer’s Instructions															
			Preventive Maintenance	1.5														

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		01 78 00	Condition Monitoring (Predictive	1.5														
			Testing)															
			Inspection	1.5														
			Instructions to be Posted	1.7.1														
			SD-10 Operation and Maintenance															
			Data															
			Equipment-in-Place List	1.3.5														
			Operation and Maintenance	1.8														
			Manuals															
			SD-11 Closeout Submittals															
			As-Built Drawings	1.3.1														
			Certification of EPA Designated	1.6	G													
			Items															
			NASA Form NF1046	1.10														
		01 86 26.07 40	SD-01 Preconstruction Submittals															
			Quality Control Plan	1.4	G													
			Material, Equipment, and Fixture	2.1	G													
			Lists															
			SD-02 Shop Drawings															
			Connection Diagrams	3.1	G													
			Fabrication Drawings	2.1.1	G													
			Installation Drawings	3.1	G													
			SD-03 Product Data															
			Manufacturer's Catalog Data	2.1.1	G													
			Equipment Foundation Data	2.1.1	G													
			Specific Equipment Data	2.1.3	G													

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		01 86 26.07 40	Spare Parts List	2.1.4	G													
			Warranty	1.5	G													
			SD-06 Test Reports															
			Automatic Transfer Test	3.3.1	G													
			Battery Impedance Test	3.3.1	G													
			Continuity Test		G													
			Fall of Potential Test	3.3.1	G													
			General Battery Test	3.3.1	G													
			General Charger Test	3.3.1	G													
			Infrared Thermography Test	3.3.1	G													
			Point to Point Test	3.3.1	G													
			Visual Inspection	3.2	G													
			SD-07 Certificates															
			Certificates	2.1.2	G													
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Instructions	3.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Operations and Maintenance	3.4	G													
			Manuals															
			SD-11 Closeout Submittals															
			Acceptance Documentation	3.5	G													
			Record Drawings	3.1	G													
			Baseline Data Report	3.3.2	G													
		02 41 00	SD-07 Certificates															
			Notifications	1.4.1	G													

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		02 41 00	Demolition plan	1.10	G													
			SD-11 Closeout Submittals															
			Receipts	1.4.2														
		05 50 13	SD-02 Shop Drawings															
			Guard posts (bollards/pipe	2.3	G													
			guards)															
			angles and plates	2.4	G													
		07 84 00	SD-02 Shop Drawings															
			Firestopping Materials	2.1														
			SD-07 Certificates															
			Firestopping Materials	2.1														
			Installer Qualifications	1.4														
		13 34 19	SD-01 Preconstruction Submittals															
			Manufacturer's Qualifications	1.6.3	G													
			SD-02 Shop Drawings															
			Detail Drawings	1.2.1.6	G													
			Detail Drawings	1.6.1	G													
			SD-03 Product Data															
			sustainable acquisition	2.4.4	G													
			compliance															
			Manufacturer's catalog data	1.6.1	G													
			SD-04 Samples															
			Metal Closure Strips	2.8.1	G													
			Insulation	1.4.8	G													
			Insulation	2.4.3	G													
			Vapor Barrier	1.6.10	G													

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		13 34 19	Manufacturer's color charts and	2.4.5	G													
			chips															
			SD-05 Design Data															
			descriptive and technical	1.6.1	G													
			literature															
			building design analysis	1.6.1	G													
			SD-06 Test Reports															
			Test reports	1.6.1	G													
			Coatings and base metals	1.6.1	G													
			Factory Color Finish Performance	1.6.1	G													
			Requirements															
			SD-07 Certificates															
			system components	1.6.1	G													
			Coil Stock	1.6.1	G													
			Coil Stock	2.1.8	G													
			Aluminized Steel Repair Paint	1.6.1	G													
			Galvanizing Repair Paint	1.6.1	G													
			Enamel Repair Paint	1.6.1	G													
			Qualification of Manufacturer	1.6.1	G													
			Qualification of Erector	1.6.1	G													
			SD-08 Manufacturer’s Instructions															
			Installation of Roof and Wall	1.6.2	G													
			panels															
			shipping, handling, and storage	1.7	G													
			SD-11 Closeout Submittals															
			Manufacturer's Warranty	3.13.1	G													

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		13 34 19	Contractor's Warranty for	3.13.2	G													
			Installation															
		26 05 00.00 40	SD-03 Product Data															
			Conduits, Raceway sand Fittings	3.1	G													
			Wire and Cable	2.2	G													
			Splices and Connectors	2.3	G													
			Switchgears		G													
			Transformers		G													
			Interrupt Switches		G													
			Circuit Breakers	2.8	G													
			Panelboards	2.7	G													
			Lamps and Lighting Fixtures	2.9	G													
			Spare Parts	1.5	G													
			Certification	1.6														
			SD-06 Test Reports															
			Continuity Test	3.11														
			Phase-Rotation Tests	3.11														
			Insulation Resistance Test	3.11														
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Instructions	1.6														
		26 05 48.00 10	SD-02 Shop Drawings															
			Switchboards		G													
			Interrupt Switches		G													
			Automatic Transfer Switches		G													
			Transformers		G													
			SD-03 Product Data															

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		26 05 48.00 10	Contractor Designed Bracing	1.2.4	G													
		26 08 00	SD-06 Test Reports															
			Acceptance tests and inspections	3.1	G													
			SD-07 Certificates															
			Qualifications	1.4.1	G													
			Acceptance test and inspections	1.4.3	G													
			procedure															
		26 12 19.00 40	SD-02 Shop Drawings															
			Pad-Mounted Transformer	1.5.1	G													
			Drawings															
			SD-03 Product Data															
			Pad-Mounted Transformers	2.1	G													
			SD-06 Test Reports															
			Acceptance Checks And Tests	3.7.1	G													
			SD-07 Certificates															
			Transformer Losses	2.1.3.1	G													
			SD-09 Manufacturer's Field															
			Reports															
			Routine And Other Tests	2.3.3	G													
			SD-10 Operation and Maintenance															
			Data															
			Transformer(s)	1.6.1	G													
			SD-11 Closeout Submittals															
			Transformer Test Schedule	2.3.1	G													
		26 20 00	SD-02 Shop Drawings															
			Panelboards	2.10	G													

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		26 20 00	Transformers	2.12	G													
			Switchboards		G													
			Autmatic Transfer Switches		G													
			SD-03 Product Data															
			Receptacles	2.9	G													
			Circuit breakers	2.10.3	G													
			Switches	2.7	G													
			Transformers	2.12	G													
			Enclosed circuit breakers	2.11	G													
			Metering		G													
			SD-06 Test Reports															
			600-volt wiring test	3.5.2	G													
			Grounding system test	3.5.4	G													
		26 23 00	SD-02 Shop Drawings															
			Switchboard Drawings	1.5.2	G													
			SD-03 Product Data															
			Switchboard	2.2														
			SD-10 Operation and Maintenance															
			Data															
			Switchboard Operation and	1.6.1	G													
			Maintenance															
			SD-11 Closeout Submittals															
			Assembled Operation and	1.6.2	G													
			Maintenance Manuals															
			Equipment Test Schedule	2.5.1	G													
			Request for Settings	3.5	G													

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CONTRACTOR

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		26 24 16.00 40	SD-02 Shop Drawings															
			Detail Drawings	1.2	G													
			Outline Drawings	1.2	G													
			SD-08 Manufacturer's Instructions															
			Panelboards	2.1	G													
		26 33 53.00 20	SD-02 Shop Drawings															
			UPS Drawings	1.6.1	G													
			UPS Installation	1.6.2	G													
			SD-03 Product Data															
			UPS Module	2.3	G													
			Factory Testing	2.11														
			UPS System	2.2														
			Spare Parts	1.10.2	G													
			SD-06 Test Reports															
			Performance Tests Report	1.6.7	G													
			Factory Tests Report	1.6.6	G													
			SD-09 Manufacturer's Field															
			Reports															
			Initial Inspection and Tests	3.2.2	G													
			Performance Tests	3.2.3	G													
			SD-10 Operation and Maintenance															
			Data															
			UPS Operation and Maintenance	1.10.1	G													
			SD-11 Closeout Submittals															
			Installation	3.1														
		26 36 23.00 20	SD-02 Shop Drawings															

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		26 36 23.00 20	Automatic Transfer Switch	1.4.2	G													
			Drawings															
			SD-03 Product Data															
			Automatic Transfer Switches	2.1	G													
			SD-06 Test Reports															
			Acceptance Checks and Tests	3.3.1	G													
			Functional Acceptance Tests	3.3.2	G													
			SD-07 Certificates															
			Proof of Listing	1.4.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Automatic Transfer Switches	2.1	G													
		31 23 00.00 20	SD-01 Preconstruction Submittals															
			Shoring and Sheeting Plan	1.7.1	G													
			Dewatering work plan	1.7.2	G													
			SD-06 Test Reports															
			Borrow Site Testing		G													
			Fill and backfill	3.12.2.1														
			Density tests	3.12.2.2														
			Moisture Content Tests	3.12.2.3														
		32 10 00	SD-05 Design Data															
			mix design	1.3.4	G													
			Asphalt concrete	2.1	G													
			Asphalt cement	2.3.1	G													
			Aggregates	2.2	G													
			Liquid asphalt	2.3.2	G													

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		32 10 00	Asphaltic emulsion	2.3.3	G													
			Paint	3.2.5.2	G													
			Reflective media	3.2.5.2	G													
			Traffic signs	2.6	G													
			SD-06 Test Reports															
			Asphalt concrete	2.1														
			SD-07 Certificates															
			mix delivery record	1.3.3														
			Asphalt concrete	2.1														
			Asphalt concrete	2.1														
			Traffic signs	2.6														
		32 13 00	SD-02 Shop Drawings															
			Formwork	1.6.2.1														
			Formwork	1.6.2.1														
			Reinforcing steel	1.6.2.2	G													
			SD-03 Product Data															
			Materials for curing concrete	2.4.6	G													
			Joint sealants	2.4.8	G													
			Joint filler	2.4.7	G													
			Reinforcement	2.5	G													
			Cement	2.4.1	G													
			Recycled Aggregate Materials	2.4.3.1	G													
			Epoxy bonding compound	2.4.9	G													
			Bonding materials	2.6	G													
			Ready-Mix Concrete	2.3.2	G													
			Curing Concrete Elements	1.6.3.1	G													

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		32 13 00	Local/Regional Materials	1.8.1	G													
			Biodegradable Form Release	2.4.10														
			Agent															
			SD-05 Design Data															
			mix design	2.3.1	G													
			SD-06 Test Reports															
			Concrete mix design	1.6.4.1	G													
			Fly ash	1.6.4.2														
			Pozzolan	1.6.4.2														
			Ground granulated blast-furnace	1.6.4.3														
			slag															
			Aggregates	1.6.4.4														
			Compressive strength tests	3.11.2.3														
			Flexural Concrete Tests	3.11.2.4														
			Air content	3.11.2.5														
			Slump	2.7.4														
			Pavement Thickness	3.11.2.5														
			Curing Concrete Elements	1.6.3.1														
			SD-07 Certificates															
			Pumping concrete	1.6.3.2														
			Biodegradable Form Release	2.4.10														
			Agent															
			VOC Content for form release	1.6.3.4														
			agents, curing compounds, and															
			concrete penetrating sealers															
			Material Safety Data Sheets	1.6.3.5														

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		32 13 00	Forest Stewardship Council	1.8.2														
			(FSC) Certification															
			SD-08 Manufacturer's Instructions															
			Fly ash	1.6.4.2														
			Ground granulated blast-furnace	1.6.4.3														
			slag															
			Steel Bar	2.5.5														

SECTION 01 35 14.11 40

AFRC SAFETY REQUIREMENTS
07/07

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 NASA's Commitment to Safety

The success of this historic agency starts with an unwavering commitment to safety. The culture of this institution is one of safe accomplishment of our missions, including construction projects. If something about this project, or any task, is unclear, it is required that you, the Contractor, ask for clarification. No activities on this project, or at this Agency, are important enough to compromise the safety of any person. If you suspect something isn't quite right, trust your instincts and your experience, and do something to correct the situation.

NASA's mission success starts with safety. A commitment to safety permeates everything we do. We are committed to protecting the safety and health of the general public, pilots and astronauts, the NASA workforce, and our high-value assets on and off the ground.

1.3 The AFRC Safety Culture

Safety at the Armstrong Flight Research Center (AFRC) is of paramount concern. We assure a commitment to safety by employing systems and processes that ensure the safety of the public, the employees, and assets. We ensure safety in all aspects of personal endeavors and we are committed to ensuring the safety of others. We take ownership for safety. We know every accident is preventable. In the spirit of the AFRC Safety Culture, the Contractor shall implement the safety provisions of this section to "make known the overlooked and unexpected" to keep all employees safe. The Contractor shall INSTRUCT ALL EMPLOYEES as to the hazards and the precautions to be taken in performance of this contract. The Contractor shall provide and maintain work environments and procedures which will safeguard Contractor employees, Subcontractors, the Public, Government personnel, and Government property, materials, supplies, and equipment exposed to Contractor operations and activities.

1.4 Construction Safety Goals

The safety provisions of this section are to be implemented by the Contractor so that:

a. Everyone involved in this project goes home as healthy as they arrived.

b. This construction work site is free of recognizable hazards.

c. We have zero lost-time accidents.

d. We have zero injuries in our workplace.

1.5 Construction Safety Strategy

In order to meet these goals every individual working onsite for the Contractor, including Subcontractors, Vendors and their employees, shall:

a. Be involved in making this project safer.

b. Know how to identify hazards.

c. Know how to report hazards and get them fixed.

d. Know their safety and health training needs, have obtained that training, and shall put the concepts to work each and every day while working on this project.

1.6 Compliance

The Contractor shall take safety and health measures in performing work under this Contract. The Contractor shall comply with all applicable federal, NASA/AFRC, Edwards Air Force Base, State and Local occupational safety and health requirements and standards. The Contractor shall take all precautions in the performance of work under this contract to protect the safety and health of the Contractor's employees, to protect the safety and health of all persons in or near the jobsite, and to prevent damage to property, materials, supplies and equipment. The Contractor shall comply with Federal OSHA Safety and Health Standards 29 CFR 1910 and 29 CFR 1926. The Contractor shall comply with the U.S. Army Corps of Engineers Safety and Health Requirements Manual in effect on the date of the solicitation.

1.7 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 F2412	(2011) Standard Test Methods for Foot Protection
ASTM F2413	(2011) Standard Specification for Performance Requirements for Protective (Safety) Toe Cap Footwear

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z89.1	(2009) American National Standard for Requirements for Industrial Head Protection

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 51B	(2014) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	(2014) National Electrical Code
NFPA 407	(2012; TIA 11-1) Standard for Aircraft Fuel Servicing

NFPA 409	(2011; Errata 11-1) Standard on Aircraft Hangars
NFPA 410	(2009) Standard on Aircraft Maintenance
NFPA 70E	(2012; Errata 2012) Standard for Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

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

10 CFR 20	Standards for Protection Against Radiation
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.501	Duty to Have Fall Protection

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

The following items shall be submitted in accordance with Paragraphs 1.8.1 "Contractor's Accident Prevention Plan" and 1.9.1 "Activity Hazard Analysis" of this section. (See also Paragraph 1.10.1 "Documents at the Jobsite" of this section).

Contractor's Accident Prevention Plan; G
Activity Hazard Analysis; G

The following Requests for Permit shall be submitted ain accordance with Paragraph 1.17 "PERMIT REQUIRED OPERATIONS" of this section.

Request for Excavation and Digging Permit; G
Request for Confined Space Entry Permit; G
Request for Utility Outage/Facility Closure Permit; G
Request for Crane Operation Permit; G
Request for Open Flame and Hotwork Permit; G
Request for Energized Electrical Work Permit; G

SD-06 Test Reports

Records shall be submitted in accordance with paragraph entitled, " Gas Protection," of this section.

SD-07 Certificates

Statements shall be submitted for the following items in accordance with paragraphs entitled, "Contractor's Accident Prevention Plan" and "Protection Plan," of this section.

Contractor's Accident Prevention Plan

Protection Plan

License Certificates

The following shall be submitted with the Contractor's "Daily Report to the Inspector" by 10:00 am the next work day in accordance with Paragraph 1.12.2 "Daily Safety Meetings/Daily Safety Inspections" of this section:

Safety Meeting/Safety Inspection sheets

Safety Meeting Attendance sheets

Confined Space Entry Training Certificates shall be submitted for all Confined Space Entry Attendants/Entry Supervisors prior to any employees entering a confined space. (See also Paragraph 1.10.1 "Documents at the Jobsite" of this section.

SD-08 Manufacturer's Instructions

Safety Data Sheets(SDS), G

SDSs for all chemicals and hazardous materials brought to the jobsite. SDSs shall be submitted in accordance with Paragraph titled "Safety Data Sheets (SDS)" and Paragraph Titled "Chemicals and Hazardous Materials" of this section. (See also Paragraph Titled "Documents at the Jobsite" of this section.)

1.8.1 Contractor's Accident Prevention Plan

Contractor shall submit an Accident Prevention Plan to the Contracting Officer for approval within 14 calendar days after notice to proceed and prior to start of construction at project site. The Accident Prevention Plan written by the prime Contractor for the specific work and hazards of this contract shall implement in detail the pertinent requirements of the US Army Corps of Engineers Safety and Health Requirements Manual. The plan shall define how the Contractor will comply with Federal OSHA Safety and Health Standards 29 CFR 1910 and 29 CFR 1926. Prior to initiation of work at the job site, the Contractor's Accident Prevention Plan shall be reviewed, found acceptable, and approved by the Contracting Officer.

Accident Prevention Plan shall be NASA/AFRC site specific and include, as a minimum, the following:

a. Safety program objectives.

b. Methods to attain safety objectives.

c. Responsibility of key personnel for the Contractor.

d. Safety meetings, surveys, inspections, and reports.

e. Disaster and emergency programs as it applies to the NASA/AFRC site.

f. Lists of key personnel to be contacted in times of emergency, along with appropriate phone numbers to be used in emergencies.

g. Program to show compliance with Federal OSHA Safety and Health Standards 29 CFR 1910 and 29 CFR 1926.

h. Methods to comply with the requirement for immediate reporting of mishaps to the Contracting Officer.

i. Statement that the Contractor will not invalidate the integrity of safety systems without proper authorization.

j. Procedures for emergency actions to be taken to secure dangerous conditions, to protect personnel, and secure work areas in the event of accident or an act of nature. This shall include procedures to secure dangerous conditions, protect personnel, and secure work areas. The plan must contain 911 telephone contact procedures specific to NASA/AFRC (See Paragraph "FIRST AID AND EMERGENCIES" of this section).

k. Procedures for securing the mishap site so that the area remains secure until arrival of a safety investigator. Mishap site will remain secured until released by the Contracting Officer.

l. A map with the location and times of operation of the NASA/AFRC medical dispensary. (This information can be obtained from the Contracting Officer.)

m. Procedures describing how chemicals, hazardous materials and hazardous wastes will be handled, managed and disposed of while at NASA/AFRC.

n. Incorporate plans for the following, as applicable: Lockout/Tagout, Confined Space, Fire Prevention, Electrical Safety, and Fall Prevention/Protection.

o. Incorporate a comprehensive site-specific heat stress monitoring plan. Drinking water shall be made available to workers and workers shall be encouraged to frequently drink small amounts; the water shall be kept reasonably cool.

1.8.2 Protection Plan

Structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations shall be protected against damage.

1.9 GENERAL SAFETY PROVISIONS

Contractor shall take safety and health measures in performing work under this Contract. Contractor shall meet with the Contracting Officer to develop a mutual understanding relative to administration of the Accident Prevention Plan. Contractor is subject to applicable federal, state, and local laws, regulations, ordinances, codes, and orders relating to safety and health in effect on the date of this Contract per NASA FAR Supplement 1852.223-70 Safety and Health.

During the performance of work under this Contract, the Contractor shall comply with procedures prescribed for control and safety of persons visiting the project site. Contractor is responsible for his personnel and for familiarizing each of his subcontractors with safety requirements. Contractor shall advise the Contracting Officer of any special safety restriction he has established so that Government personnel can be notified of these restrictions.

1.9.1 Activity Hazard Analysis

Prior to beginning each Definable Feature of Work (DFOW), an activity hazard analysis shall be prepared by the Contractor performing the work. A DFOW is defined as an operation involving a type of work presenting hazards not experienced in previous operations or where a new subcontractor or work crew is to perform. Work will not proceed on that phase until the activity hazard analysis has been accepted by the Contracting Officer and discussed with all engaged in the activity, including the Contractor, subcontractors, and government on-site representatives.

The Activity Hazard Analysis shall:

a. define the activity to be performed and identify the sequence of work,

b. define the specific hazards anticipated with the activity,

c. define the control measures to be implemented to eliminate or reduce each hazard to an acceptable level,

d. identify the equipment to be used,

e. identify the inspection requirements for that equipment and activity, and

f. list the training requirements for the workers.

1.9.2 Safety Data Sheets (SDS)

Provide the Contracting Officer with a copy of the Safety Data Sheets (formerly Material Safety Data Sheets) for all chemicals and hazardous materials to be brought on site. All manufacturers' recommended precautions shall be followed during the use of any chemical and hazardous material. SDSs must be submitted to the Contracting Officer for approval prior to the use of any chemical or hazardous substance. See also Paragraph 1.10.1 "Documents at the Jobsite" and Paragraph 1.27.1 "Chemicals and Hazardous Materials" of this section.

1.10 SAFETY COMMUNICATIONS

Accident Prevention Plans, hazard analyses, and SDSs are only effective when the workers in the field are aware of the potential hazards for that day, and take mitigation measures to work safely in that area at that time. Therefore, daily safety communications are a critical requirement. Every work day shall begin with a brief safety meeting and every work day shall include a safety inspection by the Contractor's Site Safety Officer, see Paragraph Titled "Daily Safety Meetings/Daily Safety Inspections".

Also, prior to beginning any new DFOW the Contractor shall conduct an Activity Hazard Analysis on that new class of work and shall conduct a

thorough discussion of that Activity Hazard Analysis with the workers performing the work. The Contractor shall ensure the workers understand the hazards and how to use any special tools, unique equipment, and personal protective equipment. Only after these safety analyses and communications occur shall the new class of work be allowed to proceed.

1.10.1 Documents at the Jobsite

To help maximize safety communications, the following list of documents shall be maintained on the jobsite and made easily available for the Contractor's employees and Subcontractors' employees. These records shall also be made available for Government inspection. They include but are not limited to:

a. the approved Accident Prevention Plan,

b. all approved Activity Hazard Analysis,

c. all approved SDSs,

d. all approved permit documents for Permit Required Operations that have been completed,

e. all records of lockout/tagout operations that have been completed,

f. the jobsite OSHA 300 log,

g. all training records, including Confined Space Entry Training Certificates, and

h. other records that are deemed appropriate due to the nature of the work, i.e. certificates, permits, licenses, etc.

These records shall be stored at a convenient centralized location on the jobsite. These records shall be organized, filed, and labeled in binders or file folders in a fashion that all persons involved with the project can obtain the information quickly and easily.

1.10.2 Posted Warnings and Prohibitions

The Contractor shall comply with procedures prescribed for control and safety of all persons visiting the project site. The contractor shall install all barricades and signs needed. All points of entry to the project site shall have signage warning of the inherent dangers of the work site, and reminding of the requirement to wear hard hats; also signage at specific locations throughout the work site denoting required personal protective equipment associated with the hazard(s) present. The Contractor is responsible for familiarizing each employee and each subcontractor employee with safety requirements.

All Contractor personnel are to obey all posted prohibitions, restrictions, warnings, and traffic control signs and devices. Contractor personnel shall not enter any area in which a red light is flashing without permission of the NASA area supervisor. When alarm bells are sounded in a building, secure the equipment in use and leave the building by the nearest exit. An egress passage must be maintained at all times in the work area. The Contractor shall advise employees of these requirements.

The Contractor shall advise the Contracting Officer of any special safety restrictions the Contractor has established so that Government personnel can be notified of these restrictions.

1.10.3 Display of Safety Information

The Contractor shall erect a safety bulletin board at the job site within 2 calendar days after the Contracting Officer has approved the Accident Prevention Plan. The following information shall be displayed on the safety bulletin board in clear view of the on-site construction personnel, maintained current, and protected against the elements and unauthorized removal:

a. Map denoting the route to the nearest emergency care facility.

b. Emergency phone numbers.

c. Copy of the most up-to-date Accident Prevention Plan.

d. Current AHA(s) and SDSs.

e. OSHA 300A Form.

f. OSHA Safety and Health Protection-On-The-Job Poster.

g. Safety and Health Warning Posters.

h. Active Permits.

1. Excavation and Digging,

2. Confined Space Entry,

3. Utility Outages/Facility Closures,

4. Crane Operations,

5. Open Flame and Hot Work, and

6. Energized Electrical Work.

i. Contractor is encouraged to post in a common area the number of years without a lost time construction accident at NASA's Armstrong Flight Research Center.

1.10.4 TRAINING

1.10.4.1 New Employee Indoctrination

New employees (prime, subcontractor, vendors, and suppliers) onsite will be informed of specific site hazards before they begin work. Documentation of this orientation shall be kept on file at the project site.

1.10.4.2 Periodic Training

Provide Safety and Health Training in accordance with USACE EM 385-1-1 and the approved Accident Prevention Plan. Ensure all required training has been accomplished for all onsite employees.

1.10.4.3 Training on Activity Hazard Analysis (AHA)

Prior to beginning a new phase, training will be provided to all affected employees to include a review of the AHA to be implemented.

1.11 SAFETY LOCKOUT/TAGOUT PROCEDURES

Contractor shall ensure that each employee is familiar with and complies with these procedures and 29 CFR 1910.147. Specific Lockout/Tagout requirements are as follows:

a. The tags shall be the same for both lockout and tagout, and shall only be used once. The information on the tag shall be printed legibly.

b. For lockout the information shall include - name of person controlling the lock, the date the lock was put in place, telephone number of the person controlling the lock, name of the Project Inspector monitoring the work, name of the company serving as prime contractor for the work, and the name of the company for which the lock control person is employed.

c. For tagout, the above information is required plus an explanation of why a lock could not be used, and what additional safety precautions were used to provide the same amount of safety as a lockout.

The above information shall be documented, and the record made available for inspection. Upon completion of the Lockout/Tagout Operation the documents shall be stored at the jobsite.

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.

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 equipment that requires a lockout/tagout tag unless he, his immediate supervisor, or project leader, has entered into the record such activity.

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 mechanical equipment, the apparatus, valves, and/or systems shall be secured in a non-stored energy condition with the appropriate venting, pins, blocking and locks applied.

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.

1.11.1 Tag Placement

Lockout/tagout tags shall be completed in accordance with the paragraph "SAFETY LOCKOUT/TAGOUT PROCEDURES" in this section, 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 require all employees participating in the group lockout/tagout scenario to have individual lockout/tagout locks and 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."

1.11.2 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 notify the Government of completion of the task. That group's or individual's lockout/tagout tags on equipment may only be removed on authorization by the Government after ensuring the safety of those affected.

1.12 SAFETY MEETINGS AND INSPECTIONS

1.12.1 Mutual Understanding Meeting

Before commencing the work, the Contractor shall meet with representatives of the Contracting Officer to discuss and develop a mutual understanding relative to administration of the overall safety program. Items to be discussed shall include: USACE EM 385-1-1, hard hats/safety shoes, other personal protective equipment (PPE), daily safety meetings, activity hazard analysis, frequency of inspections, 911 communications, stopping of unsafe activities, permit required operations and SDSs.

1.12.2 Daily Safety Meetings/Daily Safety Inspections

The Contractor shall conduct daily safety meetings at the beginning of each work shift. This safety meeting shall be administered by the Contractor's Site Safety Officer and/or Job Superintendent, or qualified designated representatives of these elements. This safety meeting shall be attended by all of the Contractor's employees, as well as all subcontractors and their employees working at the project site for that day. If any of these persons are not present at the daily safety meeting, they shall be briefed of the issues discussed in the meeting on an individual basis by the Contractor's Site Safety Officer prior to starting work at the site that day. The safety meeting format and discussion shall include, but not be

limited to: the schedule of events on the site for the day; addressing hazard analyses for the day's activities; allowing employees and subcontractors to submit hazard analyses and SDSs for upcoming activities; planning permit required operations; discussing unsafe conditions and near misses on the job site; discussing new equipment and material deliveries to the job site; discussing corrective actions to be taken and assignment of responsibilities for the implementation of those corrective actions.

The Contractor's designated Site Safety Officer shall, at least once per shift, conduct at least one walk-through site safety inspection of all site activities. This inspection shall be conducted at a random time during each shift. The Site Safety Officer's sole purpose during the walk-through shall be to ensure compliance with the approved Accident Prevention Plan, approved Activity Hazard Analysis, and approved SDSs. Additionally the Site Safety Officer must ensure the workers receive feedback as to their safety effectiveness and compliance with safety procedures.

The Contractor shall use the attached Safety Meeting/Safety Inspection sheets and Safety Meeting Attendance sheets, or an approved equal, to report the elements described herein. These sheets shall be submitted to the Contracting Officer on a daily basis by 10:00 am on the next work day, (with the Contractor's "Daily Report to the Inspector").

1.13 CONTRACTOR VEHICLES AND EQUIPMENT

Edwards AFB access passes for Contractor owned vehicles are included in the personnel pass and/or badging process. Proof of registration and insurance, as well as a valid driver's license, must be presented at that time.

Contractor-owned, leased, or operated equipment must be in satisfactory mechanical condition. Identification is required on both sides of all contractor vehicles and equipment, clearly identifying the contractor. While in use at the job site, rental equipment shall be kept in good working order and properly maintained. Contractor equipment, whether rented or owned, which is subject to air permit requirements must be accompanied by a copy of the air permit while on site.

Prior to a piece of rental equipment arriving on the job site, the Contractor shall present a hazard analysis for the use of the equipment. The hazard analysis shall include consideration for hazards associated with unloading, moving, and reloading the equipment. The Contractor is responsible to ensure that all employees working on or around that equipment are properly trained to use it and made aware of its associated hazards.

Hoisting and lifting devices and cranes must bear evidence of periodic inspection and dynamic load testing within the preceding 12 months and live load testing within the preceding 48 months; additionally, any more stringent ANSI and OSHA requirements for the equipment type still apply. Operators of hoisting and lifting devices and cranes shall be trained in proper use and safety limitations. The Contractor shall provide written proof of qualification for all operators of fork lifts and personnel lifts (i.e. boom lifts, platform lifts, scissors lifts, etc.). Outdoor hoisting operations shall not commence if winds are above 20 knots (23 mph) steady state or if gusts exceed 35 knots (40 mph) and the Contractor shall also comply with the manufacturer's recommended operating limits; the more restrictive shall govern.

Crane operators shall meet the requirements in USACE EM 385-1-1, Section 16

and Appendix G. In addition, for mobile cranes, crane operators shall be designated as qualified by a source that qualifies crane operators (i.e., union, a government agency, or an organization that tests and qualifies crane operators). Written proof of current qualification shall be provided.

Contractor owned vehicles which will be driven on the flight line (aircraft hangars, aprons, ramps, tow-ways, and taxiways) must bear identifying signs and property damage insurance. Access to the flight line must be authorized by the Contracting Officer. The Contractor shall be responsible for performing daily inspections of these vehicles and shall secure, remove, or dispose of all foreign objects, materials, and debris that can cause damage to an aircraft. Objects and debris lodged between tire treads shall be removed prior to driving on the flight line. All vehicles authorized by the Contracting Officer to be on aircraft maintenance ramps, fuel storage areas, and fuel servicing areas, shall comply with NFPA 407, Standards for Aircraft Fuel Servicing. All vehicles authorized by the Contracting Officer to be in aircraft hangars shall comply with NFPA 70, National Electrical Code; NFPA 410, Standard on Aircraft Maintenance; and NFPA 409, Standard on Aircraft Hangars.

Operators of motor vehicles shall be licensed. Only Contractor work vehicles, delivery vehicles, and debris hauling vehicles, driven by licensed operators, will be allowed at the work site. Vehicles for transportation of personnel or personal tools (commuting) must be parked in designated parking spaces.

The use of seat belts is mandatory by all operators and passengers traveling in motor vehicles on Edwards Air Force Base and NASA AFRC. Passengers are prohibited from riding in or on the back or bed of any truck. The speed limit, unless otherwise posted, is 15 miles per hour. The security police use radar units.

Use of Government owned equipment, tools, supplies, or materials is prohibited unless specifically authorized by the Contracting Officer.

1.13.1 VEHICLE FOREIGN OBJECT DEBRIS (FOD) PREVENTION STEPS

Cars, trucks, trailers, and mobile service vehicles that have access to aircraft operational areas are a potential source of FOD (also known as Foreign Object Damage/Debris). Prevention that should be taken includes:

a. Regularly inspect all vehicles such as refueling trucks, supply trucks, contract vehicles, and maintenance vehicles that operate on the flight line and hangar areas for foreign objects.

b. Before a vehicle is driven onto taxiways, runways, or into aircraft parking areas, the driver will stop and check that there are no rocks or pebbles caught in the tire treads and that the load is secure. The driver will also check the vehicle for loose items and secure all loose tools, hardware, trash, and other potential debris (near open windows, on exposed shelving, in pickup beds, unlocked cabinets, etc.).

c. Vehicles must not be driven off the hard surface unless absolutely necessary. If it does become necessary to drive off to let an aircraft pass or for any other reason, the driver will once again check the load for security and the tires for foreign objects before re-entering the hard surfaced area. This does not apply to emergency vehicles responding to an emergency.

d. All vehicles will enter and leave the flight line at controlled access points unless an emergency vehicle is responding to an emergency.

1.14 ACCIDENT TREATMENT AND RECORDS

Contractor shall post emergency first aid and ambulance information at project site.

1.15 FIRE PREVENTION AND PROTECTION

Open-flame, and spark-producing heating devices will not be permitted except with an Open Flame and Hot Work permit approved per paragraph "PERMIT REQUIRED OPERATIONS" in this section. Approval for the use of open fires and open-flame or spark-producing heating devices will not relieve the Contractor from the responsibility for any damage incurred because of fires.

Burning trash, brush, or wood on the project site shall not be permitted.

Any fire hazard conditions shall be immediately reported to Contracting Officer. Any fire emergency situation shall be reported by calling 911 from a NASA/AFRC phone or the NASA/AFRC Security Post #1 at (661) 276-3256. Contractor vehicles must not block or encroach upon fire truck lanes at any time. The Contractor shall provide temporary fire protection equipment for the protection of personnel and property during construction. Please reference 01 35 14.11 40 part 1.32

All work sites shall be kept clean and orderly at all times. Combustible scrap, debris, and waste materials (oily rags, paper, packaging, scrap wood, etc.) shall be stored in covered metal receptacles and removed from the worksite daily to minimize potential hazards. Flammable and combustible materials shall be stored in a manner which minimizes the risk of fire including spontaneous combustion. "No Smoking" signs shall be posted in areas where flammable or combustible material are stored.

Only UL-approved containers and tanks shall be used for storage and handling of flammable and combustible liquid. All flammable and combustible liquids shall be kept in closed containers when not in use. Bulk drums of flammable or combustible liquids shall be grounded and bonded to containers during dispensing. The Contractor shall provide and be equipped with one full 10 pound 4-A:60 BC multipurpose dry chemical fire extinguisher placed within 20 feet where flammable/combustible liquids are stored.

The Contractor shall ensure the following are complied with when pressurized cylinders are on the jobsite:

a. Cylinder contents shall be identified with a label.

b. All cylinders shall be stored in an upright position at all times.

c. Cylinders shall be secured at all times.

d. Cylinders not in use shall have valve protector caps in place.

Smoking is not permitted in buildings or on roofs. Smoking is permitted in approved designated areas only. Smoking materials shall be disposed in an approved receptacle.

Nonspark producing tools and equipment or pneumatic type shall be utilized in fire hazardous areas such as hangars and other explosive environment areas. Burning of trash or rubbish is prohibited.

Dispensing of flammable and combustible liquids is not permitted in buildings or on roofs.

1.16 USE OF EXPLOSIVES

Explosives shall not be used or brought to the project site without written approval of the Contracting Officer. Explosive-actuated (or powder-actuated) fastening tools are not subject to this constraint if designed, inspected and operated per EM 385-1-1.

1.17 PERMIT REQUIRED OPERATIONS

The Contractor shall coordinate with the Contracting Officer and obtain written approval from the Contracting Officer on all Permit Required Operations before the operation begins. The Contractor shall initiate coordination with the Contracting Officer by writing and submitting a Request for Permit. The Contractor shall provide, with the Request for Permit the following:

a. Work Plan - A written work plan describing the work to be accomplished during the Permit Required Operation including a schedule to be followed. The schedule shall include the dates and time period the Contractor contemplates performing the operation.

b. Activity Hazard Analysis - An activity hazard analysis of the proposed activities during the Permit Required Operation including the Contractor's plan to minimize or eliminate any hazards associated with the performance of the work. See paragraph 1.9.1

The permits are primarily used to identify potentially hazardous work conditions in an attempt to prevent accidents. The permits are also used to coordinate the required work with key AFRC activities and keep customer inconvenience to a minimum. The permits shall be processed just prior to the start of the operation. Permit forms will be provided and filled out by the Government. The Contractor shall post approved permits at a conspicuous location in the construction area near the permitted operation. Upon completion of the Permit Required Operation a copy of the approved permit documents shall be stored at the jobsite in accordance with Paragraph "Documents at the Jobsite" of this section. Permit required operations are:

1. Excavation and Digging,

2. Confined Space Entry,

3. Utility Outages/Facility Closures,

4. Crane Operations,

5. Open Flame and Hot Work, and

6. Energized Electrical Work.

1.17.1 Excavation and Digging

Surface penetration, excavation, digging, and trenching are Permit Required Operations. Surface penetration, excavation, digging, and trenching operations must be approved by the Contracting Officer before operations begin. The Contractor shall obtain this approval by submitting a written Request for Excavation and Digging Permit in accordance with Paragraph 1.17 "PERMIT REQUIRED OPERATIONS". The Contractor shall submit this request to the Contracting Officer seven (7) calendar days prior to the start of digging operations, to enable the Contracting Officer to review measures being taken to prevent hazard to employees and possible damage to subsurface utilities.

The permit, a NASA - AFRC EXCAVATION AND DIGGING PERMIT (Form D-WK 808-8), must be filled out by the Government and attached to the Contractor's Request for Excavation and Digging Permit. This package must be reviewed and approved by several AFRC and USAF organizations prior to start of surface penetration, excavation, digging, or trenching. During this review and approval period the Contractor can proceed with marking and staking activities described below.

Prior to performing any surface penetrations, excavation, digging, or trenching 6 inches or deeper (including driving stakes more than 6 inches in the ground) on any ground surface, the Contractor shall obtain from the Contracting Officer the current subsurface utility drawing of the particular area to be worked on. All utility lines shall be identified and marked in the field. The Contractor shall stake out, mark, paint lines, or other wise identify all subsurface pressurized gas pipes, high voltage cables, communication cables, other pipe lines, and other subsurface structures indicated within the area of the work before any surface penetration, excavation, digging, or trenching is done. After identification is complete, the Contractor shall obtain agreement from the Contracting Officer that identification is sufficient. After obtaining the approved permit package from the Contracting Officer and completing the marking and staking activities, the Contractor shall proceed with the excavating and digging operation in accordance with the approved permit documents.

The Contractor, however, shall temporarily halt any powered equipment digging and machine excavation work (i.e. backhoe, jackhammer, trencher, auger, etc.) when approaching within 10 feet of the staked-out/marked utility until the Contractor has exposed the utility by hand excavation to fix its location. The utility must be exposed carefully (i.e. "pot holing") using hand digging methods or with a hydro-vacuum excavator or alternative approved by the Contracting Officer. The Contractor shall obtain agreement from the Contracting Officer on how much closer to the utility the machine excavations can be allowed. Powered equipment digging shall not be performed within 5 feet of any utility. All powered equipment must be positioned so that it cannot come any closer than 5 feet from the utility. Backhoes must be positioned so that when the arm is in the full extension it cannot come any closer than 5 feet to the utility and the arm must always be drawn away from the utility thus pulling material toward the operator and away from the utility.

1.17.2 CONFINED SPACE

Comply with the requirements in 29 CFR 1910.146. Any potential for a hazard in the confined space requires a permit system to be used. Comply with the requirements in 29 CFR 1910.146.

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. (See Local Authority for entry procedures prior to entering confined space).

   All hazards pertaining to the space shall be reviewed with each employee before entry.

b. Provide forced air ventilation for confined space entry operations if required..

c. Ensure the use of rescue and retrieval devices in confined spaces greater than 5 feet in depth.

d. Sewer waste walls require continuous atmosphere monitoring with audible alarm for toxic gas detection.

e. Include training information for employees who will be involved as entrant attendants for the work.

f. Entry Permit. Use forms D-WK 223-8 "Confined Space Entry Permit", D-WK 224-8 "Non-Permit Confined Space Checklist", and/or D-WK 225-8 "Confined Space Evaluation" or other form with the same minimum information for the Confined Space Entry Permit, completed by the qualified person. Post the permit in a conspicuous place close to the confined space entrance.

Entering a confined space is a Permit Required Operation. Entering a manhole, underground vault, sewage pit, vessel, tank, subfloor area, or other confined space is a permit required operation. Safety clearance from the Contracting Officer is required before any Contractor personnel enter a manhole or vault or any other confined space. Entry must be assessed under Confined Space guidelines. Permit Required Confined Space regulations shall be followed during all confined space entries. Confined space operations must be approved by the Contracting Officer before operations begin. The Contractor shall obtain this approval by submitting a written Request for Confined Space Entry Permit in accordance with Paragraph 1.8 "PERMIT REQUIRED OPERATIONS". The Contractor shall submit this request to the Contracting Officer three (3) calendar days prior to the start of these operations, to enable the Contracting Officer to review measures being taken to prevent hazard to employees.

The permit, a CONFINED SPACE ENTRY PERMIT (forms D-WK 223-8, D-WK 224-8, and/or D-WK 225-8), must be filled out by the Government and attached to the Contractor's Request for Confined Space Entry Permit. This package must be reviewed and approved by the Armstrong Safety Office and approved by the Contracting Officer prior to entry. After obtaining the approved permit package from the Contracting Officer, the Contractor shall proceed with the confined space operation in accordance with the approved permit documents. The Contractor shall also comply with the requirements stated below.

1.17.2.1 Confined Space - Gas Protection

All work within manholes and other confined spaces shall be considered

permit required confined space entry work, unless otherwise designated by the Contracting Officer. Contractor shall be responsible for removing water and debris before commencement and during execution of work in manholes and vaults. The Contractor shall have one or more confined space entry attendants/entry supervisors who are properly trained in the operation of gas monitoring equipment and formally qualified as confined space entry attendants/entry supervisors who shall be on duty during times workmen are in confined spaces. Their primary functions shall be to monitor the confined space and operate testing and alarm equipment. Gas monitoring shall be performed prior to entry and continuously when anyone is in the confined space. Readings shall be permanently recorded daily, indicating the concentration of gas, location/point of test and time the space was monitored.

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

1.17.3 Utility Outages/Facility Closures

Turning a utility off or on is a Permit Required Operation. Closing a facility or part of a facility is a Permit Required Operation. Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the Contracting Officer. Utility outages and facility closures must be approved by the Contracting Officer before outages and closures begin. The Contractor shall obtain this approval by submitting a written Request for Utility Outage/Facility Closure Permit in accordance with Paragraph 1.17 "PERMIT REQUIRED OPERATIONS". The Contractor shall submit this request to the Contracting Officer fourteen (14) calendar days in advance of the planned outage or closure, to enable the Contracting Officer to review measures being taken to prevent hazard to employees and the public, to prevent interruption of any required service, to coordinate the required work with key Center activities, and keep Center impact to a minimum.

The permit, a FACILITY OUTAGES AND CLOSURES APPROVAL (form DFRC-113), must be filled out by the Government and attached to the Contractor's Request for Utility Outage/Facility Closure Permit. This package must be reviewed and approved by the Center's Safety Office, the Facilities Engineering & Asset Management Office, the affected Building/Area Manager, and the Contracting Officer prior to initiation of the outage or closure. Notification must also be made to the AFRC Security Office, the AFRC Information Systems Branch, and Center Management. After obtaining the approved permit package from the Contracting Officer, the Contractor shall proceed with the work requiring an outage or closure in accordance with the approved permit documents. The Contractor shall also comply with the requirements stated below.

The shut-down and start-up of the utilities for the outage shall be performed by the Government and not the Contractor.

Contractors shall not shut down, shut off, disconnect, block, or otherwise impair any fire protection sprinkler system, fire hydrant, fire alarm system, special extinguishing or other installed fire protection system. The Government will provide support for these activities only with an

approved FACILITY OUTAGES AND CLOSURES APPROVAL (form DFRC-113).

1.17.4 Crane Operations

Operating a crane is a Permit Required Operation. Setting up a crane is a Permit Required Operation. Cranes shall not be operated without written permission from the Contracting Officer. Crane operations must be approved by the Contracting Officer before crane setup begins. The Contractor shall obtain this approval by submitting a written Request for Crane Operation Permit in accordance with Paragraph 1.17 "PERMIT REQUIRED OPERATIONS". The Contractor shall submit this request to the Contracting Officer seven (7) calendar days in advance of the planned crane operation to enable the Contracting Officer to review measures being taken to prevent hazard to employees and the public, to prevent interruption of any required service, to coordinate the required work with key Center activities, and keep Center impact to a minimum.

The permit, a CRANE OPERATION APPROVAL (D-WK-800-8), must be filled out by the Government and attached to the Contractor's Plans. The contractor shall prepare the following plans/documents:

1. Description of Work,

List the work to be accomplished during the lifting operation

2. Center Impact Analysis,

List the affects this activity will have on Center occupants and Center operations, i.e. evacuate portions of a building, close a fire lane, require special secure access, close a building exit/entrance, etc.

3. Activity Hazard Analysis

Per paragraph 1.9.1

4. Lift Plan

a. The exact size and weight of the load.

b. The maximum load limits for the entire range of the lift.

c. Height of the lift.

d. The lift geometry and sequence of actions.

e. The load radius.

f. The boom length and angle, for the entire range of the lift.

g. Ground conditions and outrigger and mats requirements.

h. A drawing showing the location of the crane and the "from" and "to" pick points, including adjacent buildings, utilities, and other obstructions or hazards.

i. Rigging procedures and rigging hardware.

j. Proof of qualification for the crane operator, including a current physician's certificate that meets the requirements of

USACE EM 385-1-1, Appendix G (Procedures for the Examination and Qualification of Crane Operators).

k. Environmental conditions under which lift operations are to be stopped.

l. Communication and coordination requirements.

m. The Contractor shall make Personnel Assignments and clearly list by name who will be the Lift Director, Crane Operator, Signalman, Rigger, and Tag Line Persons.

n. The Contractor shall also complete the Crane Safety Checklist prior to commencing lifting operations.

o. The Contractor shall perform a practice pick without the load to verify estimated boom angle(s) required to pick, rotate, and set the load.

This package must be reviewed and approved by the Lift Supervisor and the Chief of Facilities Engineering & Asset Management Office prior to initiation of the crane setup. The Chief of Facilities Engineering & Asset Management Office will assign the Lift Supervisor. Notification must also be made, by NASA project personnel, to the AFRC Security Office, the AFRC Safety Office, and Center Management prior to lifting operations. After obtaining the approved permit package from the Contracting Officer, the Contractor shall proceed with the crane operation in accordance with the approved permit documents.

Crane Safety Checklist for Facility Lifts:

Things to check

1. Crane certifications and documents have been checked and are current, including:
    a. Current physician's certificate.
    b. Insurance.
    c. Pre-lift Safety Meeting minutes.
2. Operator certifications have been checked and are current.
3. Ancillary lifting equipment certifications (slings, chokers, etc.) are current.
4. Boom angle needed to reach both pick point and set points have been checked and capacity of the crane (AT THOSE BOOM ANGLES) is sufficient to lift the intended load.
5. Capacity of the crane at the horizontal angles required for the pick, rotation, and set have been checked against crane manual and capacity is sufficient for the intended load. (Note: Some cranes, especially crawler cranes that don't have outriggers, DO NOT have the same capacity to the side that they do to the front.)
6. There is sufficient room for crane counterweights to miss all obstructions when the crane rotates horizontally.
7. Clip on crane hook has sufficient spring tension.
8. All people in area are wearing hard hats and safety shoes.
9. Person who is signaling crane operator has been designated and everyone understands who that person is for this operation.
10. Lift Supervisor has been designated and everyone understands who that person is for this operation.
11. Personnel handling tag lines have been designated and they understand that they are not allowed under the load.

12. Ground where outriggers are set has sufficient capacity to resist "punching shear" force which is generated from load and expected geometric configuration of crane.
13. Check for overhead electrical lines within boom radius + 20 feet. Brief the Chief, Facilities Engineering & Asset Management Office on proposed mitigation procedures.
14. Check for underground vaults, tanks, or utilities near the crane location that might collapse or shift causing the crane to shift or sink while under load.
15. Ensure the lifting/hazardous zone is delineated clearly to public (use cones, caution tape, fencing, or other.)

Things to do

1. Practice pick shall be made prior to actual lift in order to verify estimated boom angle(s) required to pick the load, rotate the load, and set the load. (Note: This is done without the load.)

1.17.5 Open Flame and Hot Work

The use of an open flame is a Permit Required Operation. Hot work such as welding, torch cutting, sawing metals, flame cutting, burning, grinding, brazing, soldering, and cad welding are all Permit Required Operations. Applying, installing, or removing building materials through the use of heat are also Permit Required Operations. Any operation that can result in the generation of hot flying debris or sparks is a Permit Required Operation. During operations involving possible fire hazard, the Contractor shall notify the Contracting Officer and not proceed until approval is obtained in writing. Open flame and hot work operations must be in compliance with NFPA 51B, and approved by the Contracting Officer before operations begin. The Contractor shall obtain this approval by submitting a written Request for Open Flame and Hot Work Permit in accordance with Paragraph 1.17 "PERMIT REQUIRED OPERATIONS". The Contractor shall submit this request to the Contracting Officer three (3) calendar days prior to the start of these operations, to enable the Contracting Officer to review measures being taken to prevent hazard to employees, prevent possible fire damage to equipment and property, and prevent unnecessary activation of fire suppression/alarm systems.

The permit, a USAF WELDING, CUTTING AND BRAZING PERMIT, (AF Form 592), must be filled out by the Government and attached to the Contractor's Request for Open Flame and Hot Work Permit. This package must be reviewed and approved by the AFRC Safety Office and approved by the Contracting Officer prior to start of open flame and hot work. After obtaining the approved permit package from the Contracting Officer, the Contractor shall proceed with the open flame and hot work operation in accordance with the approved permit documents. The Contractor or Subcontractor performing the operation shall sign the permit before any open flame and hot work operation is started. The Contractor shall also comply with the requirements stated below.

The Contractor shall discontinue open flame or hot work operations 60 minutes prior to the end of the normal work day. A Contractor employee shall be assigned as Fire Watchman for every open flame and hot work operation. The Watchman shall be equipped with suitable fire extinguishers and shall check all areas around and below the welding or burning operation for fires. The check shall be continued for at least 60 minutes after completion of the open flame or hot work operation to ensure no possible sources of latent combustion, this requirement may be reduced to no less

than 30 minutes by the CO based on the fire hazard.

The Contractor shall provide portable fire extinguishers for fire safety during open flame and hot work operations. When conducting open flame and hot work operations on roofs, the Contractor shall provide and be equipped with one full 20 pound 20-A:120 BC multipurpose dry chemical fire extinguisher and one 2.5 gallon water pressure/spray-pump type portable fire extinguisher placed within 30 feet of the operation. For all other open flame and hot work operations the Contractor shall provide and be equipped with one full 10 pound 4-A:60 BC multipurpose dry chemical fire extinguisher and one 2.5 gallon water pressure/spray-pump type portable fire extinguisher placed within 30 feet of the operation. The Contracting Officer may request a standby from the Local Fire Department; this accommodation does not relieve the Contractor of responsibility for open flame and hot work safety.

Upon completion of open flame or hot work operation (or expiration of Permit), the permit shall be returned to the government.

1.17.6 Energized Electrical Work

Work on an energized electrical system is a Permit Required Operation. Whenever possible, all lines, circuits, and equipment to be worked on shall be de-energized before work is started. If work must be performed on an energized electrical system that cannot be shut-down and the system will remain energized during the work, the Contractor shall submit a Request for Energized Electrical Work Permit to the Contracting Officer.

Request for Energized Electrical Work Permit shall include:

1. Description of circuit, equipment, or job location.

2. Description of work to be done.

3. Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next Government-scheduled outage.

4. Names of personnel authorized by the Contractor to perform the work on energized electrical equipment.

If the Government determines that the Energized Electrical Work Permit is necessary, the Government will complete and attach AFRC Form D-WK 232 to the Contractor's Request for Energized Electrical Work Permit prior to approval. Approval from the Contracting Officer shall be obtained by the Contractor prior to performing work on energized lines, circuits, and equipment per "PERMIT REQUIRED OPERATIONS" instructions paragraph in this section. The Contractor shall provide and utilize all necessary personal protective equipment and other protective controls to work on energized lines, circuits, and equipment NFPA 70E.

1.18 ELECTRICAL SAFETY

Contractor shall appoint an individual responsible for the electrical safety of each work team to restrict entry to dangerous locations to those authorized by him jointly with the Government. Lockout/Tagout controls will be strictly enforced.

The Contractor shall use Ground Fault Circuit Interrupters (GFCI) in all

circuits used for electric tools and equipment in the construction site. The Contractor shall use GFCIs in all circuits used for temporary lighting in the construction site. GFCIs shall be installed in accordance with the most recent edition of the National Electric Code.

1.19 UNDERGROUND UTILITIES

Safety clearance from the Contracting Officer is required before any Contractor personnel enter a manhole. Contractor shall contact the Contracting Officer for support services at least 24 hours in advance.

Contractor shall be responsible for removing water and debris before commencement and during execution of work in manholes.

1.19.1 PROTECTION OF EXISTING UTILITIES

Existing utilities that are indicated, or the location of which is made known to the Contractor prior to beginning of operations, and utility lines constructed during the Contractor's operation, shall be protected from damage. If the Contractor damages any of these utilities they shall be repaired by the Contractor at no additional cost to the Government. In the event that the Contractor damages any existing utility lines that are not indicated or the locations of which are not known to the Contractor, report thereof shall be made immediately to the Contracting Officer. If the Contracting Officer determines that repairs shall be made by the Contractor, such repairs will be ordered under the clause of the general provisions of the contract entitled "Differing Site Conditions".

1.20 RADIATION SAFETY REQUIREMENTS

License Certificates for radiation materials and equipment shall be submitted to the Contracting Officer for all specialized material and equipment that could cause fatal harm to construction personnel or to the construction project.

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

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

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

In instances where radiography is scheduled near or adjacent to buildings or areas having limited access or one-way doors, no assumptions shall be made as to building occupancy. Where necessary, the Contracting Officer will direct the Contractor to conduct an actual building entry, search, and alert. Where removal of personnel from such a building cannot be accomplished and it is otherwise safe to proceed with the radiography, a fully instructed employee shall be positioned inside such building or area to prevent exiting while external radiographic operations are in process.

Use of equipment containing radioactive isotopes or any nuclear sources such as density test, moisture detectors, radiography, etc. must be approved by the AFRC Safety Office and the Contracting Officer. If such equipment is to be used in the work, the Contractor must notify the AFRC Safety Office through the Contracting Officer no less than 14 days prior to the use of such equipment. During the use of such equipment the AFRC

Safety Office is authorized to make periodic checks to insure that proper health precautions are being followed. If the AFRC Safety Office determines that these precautions are not being followed, the AFRC Safety Office will immediately notify the Contracting Officer to initiate corrective actions.

1.21 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.

1.22 PROTECTION OF WORK

Prior to performing any excavation work or any surface penetrations 6 inches or deeper (such as driving stakes more than 6 inches in the ground) on any ground surface, the Contractor shall obtain from the Contracting Officer the current subsurface utility drawing of the particular area to be worked on. Contractor shall stake out subsurface utilities, communication cables and pipe lines indicated within the area of work.

Contractor shall notify the Contracting Officer, 48 hours prior to the start of excavation work or surface penetration, to enable the Contracting Officer to review measures being taken to prevent hazard to employees and possible damage to subsurface utilities. Where emergency conditions preclude the 48 hours advance notification, the Contractor shall immediately inform the Contracting Officer of his intention to initiate work prior to actual start of activity.

After obtaining clearance from the Contracting Officer, the Contractor shall proceed with excavating work, or other surface penetration work. Contractor shall temporarily halt any machine excavation work or other surface penetration when approaching 10 feet of an existing utility line until the Contractor has exposed the utility line by hand excavation.

1.23 ROOFING AND COATING

At the beginning of each work day the Contractor shall check with the Contracting Officer before proceeding to work on the roof to ensure safe work conditions. Contractor shall comply with 29 CFR 1926.

1.24 HIGH NOISE LEVEL PROTECTION

Operations performed by the Contractor that involve the use of equipment with output of high noise levels (jackhammers, drill hammers, generators, tractors, saws, air compressors, and explosive-activated tools, etc.) shall be scheduled for weekends and/or outside normal duty hours. Contractor operations that result in noise levels above 60 dBA in any occupied buildings (offices, laboratories, control rooms, hangars, etc.) and are disruptive to NASA/AFRC business operations shall be performed on weekends or outside normal duty hours. Use of any such equipment shall be approved in writing by the Contracting Officer prior to commencement of work. (Normal duty hours defined in Section 01 14 00 "Work Restrictions", Paragraph 1.2.2 "Normal Duty Hours").

Contractor personnel working at NASA/AFRC may need to wear hearing protection as a result of normal aircraft operations. Sonic boom shock waves are a normal everyday occurrence at NASA/AFRC that cause momentary surprise to personnel. The Contractor shall instruct all employees to be

aware of this hazard, especially working outdoors at heights or near heavy loads.

1.25 SEVERE STORM PLAN

In the event of a severe storm warning, or indications of impending severe weather (e.g. dust storms, damaging wind, heavy rains, floods, tornados, hail, or lightning) the Contractor shall monitor weather conditions and take appropriate precautions including but not limited to:

a. Secure outside equipment and materials and place materials possible to damage in protected locations.

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.

d. Secure materials and equipment that should not be exposed to, or contaminated with, dirt and dust to protect the materials and equipment from damage. This includes mechanical, electrical, and electronic equipment to ensure their function is not compromised. This also includes materials that have aesthetic purpose to ensure appearance is not damaged.

1.26 HAZARDOUS MATERIALS AND WASTE

When working with hazardous materials and hazardous waste, Contractor personnel must wear or use personal protective articles such as protective clothing, respiratory devices, protective shields, etc., appropriate to the task being performed. Provisions are to be made by the Contractor for continuous contact with personnel working with hazardous waste/materials in remote areas.

Contractor shall identify all wastes produced and dispose of them in the following approved manners:

Identify all wastes and waste producing processes including chemicals, paints, Petroleum, Oil and Lubricant (POL) products and solvents, and their containers. All unknown wastes shall be chemically identified.

Obtain a determination of whether the waste is hazardous from the Contracting Officer.

Notify the Contracting Officer prior to taking disposal action for any hazardous waste.

Notify the Contracting Officer of leaks or releases of ozone depleting substances in equipment with a charge of 50 pounds or more.

For disposal, provide either laboratory analysis data documenting the chemical content of the waste or certification by appropriate organization authority as to the chemical constituents of the waste. Technical assistance on disposal analysis requirements will be provided on request by contacting the Contracting Officer.

Document the waste type, quantity, location, and personnel/contractor/ agency responsible so the material can be tracked from generation through

ultimate disposal as required by Environmental Protection Agency under Resource Conservation and Recovery Act.

1.26.1 Chemicals and Hazardous Materials

No chemicals and no hazardous materials such as flammables, sources of ionizing radiation, corrosives, or toxic substances may be brought onto NASA/AFRC premises without authorization from the Contracting Officer. Provide the Contracting Officer with a copy of the Safety Data Sheets (SDSs) for all chemicals and hazardous materials to be brought on site. All manufacturer recommended precautions shall be followed during the use of any chemicals and hazardous material. SDSs will be required of all substances deemed to be hazardous by the Contracting Officer. SDSs must be submitted to the Contracting Officer for approval prior to the use of any chemicals and hazardous substance.

1.26.2 Asbestos, Lead Paint, and PCBs

Any work in or around asbestos containing material (ACM) or suspect ACM, including but not limited to insulation; fire proofing; ceiling tiles; flooring materials; roofing materials; or transite, gypsum board, plaster and hollow cell walls, must be approved by the Contracting Officer prior to commencing work.

The use of any construction materials containing asbestos is prohibited.

In the event suspect ACM is identified, and was not previously identified, the contractor shall immediately cease work in the vicinity and inform the Contracting Officer.

Any work involving the disturbance of lead based paint or suspect lead based paint must be approved by the Contracting Officer prior to commencing work.

In the event suspect lead based paint is identified, and was not previously identified, the contractor shall immediately cease work in the vicinity and inform the Contracting Officer.

The use of any paints containing lead or zinc chromate is prohibited.

Any work involving the disturbance of PCBs must be cleared through the Contracting Officer.

1.27 BARRICADING WORK AREAS

Areas made hazardous to workers, project personnel, the public, or other persons by Contractor operations shall be barricaded as follows:

a. All lay down areas, excavations, breaks in roads, breaks in floors, and similar conditions shall be barricaded to prevent injury to personnel and reduce the possibility of damage to moving equipment. The Contractor shall continuously barricade all lay down areas, excavations, breaks in roads, breaks in floors, and similar conditions with temporary vertical chain link fencing or vertical plywood fencing.

b. When the lay down areas, excavations, breaks in roads, breaks in floors, and similar conditions are within 20 feet of the edge of roads, parking lots, and pedestrian routes, the Contractor shall furnish and install battery powered flasher type warning lights on a maximum

spacing of not less than one flasher every 15 feet on at least one side of any excavation or opening.

c. Steel plates used to cover excavations in roadways shall be sufficient to safely support all vehicle loads.

d. Identify and flag all fire sprinkler heads when using ladders in work area.

1.28 FALL HAZARDS

When work is performed at heights which expose workers, project personnel, the public, other persons, or assets to falling objects, such areas shall be barricaded, restricted, or protected.

When work is performed at heights which expose workers, and inspectors to falls, the Contractor shall provide fall protection. The Contractor shall submit for approval to the Contracting Officer a site specific fall protection plan for each DFOW before commencing roofing work, any activity on a roof, or any activity that subjects employees to a fall of greater than 6 feet or a fall into an inherent hazard. The Contractor shall ensure safe work conditions during such work, including safety provisions for wall openings, floor openings, and unguarded edges. When working from an aerial lift workers shall use a body harness and lanyard system appropriately attached to the manufacturer's attachment point(s).

Per 29 CFR 1926.501, each employee on a walking/working surface with an unprotected side or edge which is 6 feet or more in height above a lower level shall be protected from falling by a system correctly suited to the area of hazard (e.g. guardrail system, safety net system, or personal fall arrest system, etc.).

1.29 PERSONAL PROTECTIVE AND SAFETY EQUIPMENT

All construction areas at AFRC are considered hard hat areas. All persons working on or visiting the project site shall wear hard hats (Type I or Type II per ANSI/ISEA Z89.1), and be used in accordance with manufacturers recommendations concerning: inspection, maintenance, donning and useful life span.

All Contractor employees and Subcontractors shall wear clothing suitable for the weather and work conditions. The minimum for field work shall be short sleeve shirt, long trousers, and appropriate hard-toed safety boots per (ASTM F2412 & ASTM F2413). Additional equipment shall be worn as necessary by work conditions, including safety glasses, face shields, shade lenses, and other PPE specified in this section.

For purposes of inspecting the work under this contract, the Contractor shall provide personal protective and safety equipment to the Government inspector for use during inspections. This includes but is not limited to personal fall protection systems (such as body harnesses, lanyards, lifelines), ladders, aerial lifts, hearing protection, respirators, safety glasses, face shields, shade lenses, etc. This does not include hard hats and steel-toed safety boots.

1.30 ENVIRONMENTAL PROTECTION

The environmental resources within the project boundaries and those affected outside the limits of permanent work under this contract shall be

protected during the entire period of this contract.

1.30.1 Desert Tortoise Protection

The Desert Tortoise is a threatened species under the Federal Endangered Species Act, and the Contractor shall ensure that they are protected throughout the project site. For work sites outside the NASA AFRC fenceline, but within the lease boundary, the superintendent and all contract employees involved in earthwork operations shall view a NASA training film about the Desert Tortoise, approximately 1 hour long. The Contractor shall take extreme care to protect the Desert Tortoise when in the clean soil disposal site.

1.30.2 Migratory Birds

Migratory birds nest in the area yearly and are protected under the Migratory Bird Treaty Act (MBTA). Nests may occur on the ground, in burrows or culverts, in vegetation (such as cattails), or on manmade structures (such as buildings, radar towers, static plane displays, catwalks, rafters, pipe, etc.). If an active bird nest (nest with eggs, unfledged birds, or adult birds observed in the nest) is found within the project area and cannot be avoided, Contractor shall cease work immediately and notify the Contracting Officer.

1.30.3 Cultural Resource Protection

In order to avoid disturbing sensitive or historical materials/artifacts, Contractor shall use existing graded or permanent roads and staging areas and avoid accessing the lakebed. Contracting Officer may allow additional access inside the project boundary, or adjust the project boundary as necessary.

In the event cultural or historical materials are found during the performance of this contract, work will cease immediately in the find area and the Contracting Officer shall be notified accordingly.

1.30.4 Air Quality

The Contractor's operations shall satisfy air quality requirements for Eastern Kern Air Pollution Control District, including permits for all temporary, portable construction equipment with internal combustion engines rated over 50 bhp. Earth moving vehicles such as dump trucks, CATs etc. shall not be left in idle for longer than 3 minutes, unless being actively used on the work site.

1.30.5 Water Quality

The Contractor's operations shall satisfy water quality requirements for the Lahontan Regional Water Quality Control Board.

1.31 DUST CONTROL

The Contractor shall maintain excavations, embankments, stockpiles, temporary roads, plant sites, waste areas, borrow areas, and other work areas within or beyond the project site free from dust which would cause a hazard or nuisance to others. Methods of stabilization consisting of water sprinkling, chemical treatment, light bituminous treatment or similar methods will be permitted to control dust. Sprinkling shall be repeated at such intervals as to keep the disturbed area damp at all times. Dust

control shall be performed as the work proceeds and whenever a nuisance or hazard occurs. During high wind conditions, operations shall be stopped until wind levels drop low enough that dust controls will be effective. During high wind conditions, open storage piles and vehicles hauling bulk materials shall be covered.

When the jobsite is inside an occupied building, the Contractor shall provide and install dust barriers to control dust movement so that dirt and dust does not migrate out of the construction site and into occupied sections of the building. Any corridors, offices, and other rooms that become contaminated by dirt and dust migrating from the Contractor's activity shall be cleaned, dusted, and vacuumed by the Contractor at no expense to the Government.

1.32 FIRST AID AND EMERGENCIES

The contractor shall maintain a 16-unit first aid kit on the job site clearly located and marked. The Contractor's Site Safety Officer shall inspect the kit every work day; see Paragraph 1.12.2 "Daily Safety Meetings/Daily Safety Inspections".

Contractor personnel who sustain injury or become ill, on-site during normal duty hours, may be examined and/or given first aid treatment at the NASA/AFRC Dispensary in Building 4822, telephone (661) 276-3258 or (661) 276-3570. Outside normal duty hours the Contractor is responsible for first aid treatment of employees and transportation to a medical facility off-site. All injuries sustained on-site must be reported to the Contracting Officer whether treated at the NASA/AFRC facility or elsewhere. (Normal duty hours are defined in Section 01 14 00 "Work Restrictions".)

Emergency telephone numbers and reporting instructions shall be conspicuously posted at the job site. Fire, rescue, and first aid are available by contacting 911 on a NASA/AFRC telephone. If a NASA/AFRC phone is not available in an emergency, call Security post 1 at (661) 276-3256 and clearly explain the emergency. A direct 911 contact cannot be made by use of a personal or cellular phone. To summarize, in an emergency from:

a. NASA/AFRC phone	dial	911
b. Personal or Cellular phone	dial	(661) 276-3256

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 35 40.00 20

ENVIRONMENTAL MANAGEMENT
02/10

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 Z400.1/Z129.1	(2010) Hazardous Workplace Chemicals - Hazard Evaluation and Safety Data Sheet and Precautionary Labeling Preparation

ASTM INTERNATIONAL (ASTM)

ASTM D 4840	(1999; R 2010) Sampling Chain-Of-Custody Procedures
ASTM D 5663	(1997; R 2003) Validating Recycled Content in Packaging Paper and Paperboard
ASTM E 2114	(2008) Standard Terminology for Sustainability Relative to the Performance of Buildings

U.S. DEPARTMENT OF AGRICULTURE (USDA)

Biomass R&D Act	(2000) Biomass Research and Development Act
U.S. Farm Bill	(2002) U.S. Farm Bill of May 2002

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

NPDES	(1972; R 2005) National Pollutant Discharge Elimination System

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

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

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

1.2 DEFINITIONS

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

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

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

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

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

1.3 PRECONSTRUCTION MEETING

After award of Contract and prior to commencement of the work, the Contractor shall schedule and conduct a meeting with the Contracting Officer to discuss the proposed Environmental Protection Plan and to develop a mutual understanding relative to the details of environmental protection. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting as specified in Section 01 45 00.10 40 CONTRACTOR QUALITY CONTROL.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G

Instructor Qualifications

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

SD-03 Product Data

Packaging; (LEED)

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

SD-06 Test Reports

Field Quality Control Reports

SD-07 Certificates

Environmental Regulatory Requirements

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

SD-08 Manufacturer's Instructions

Safety Data Sheets

SD-11 Closeout Submittals

Training Program

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

Protection of Natural Resources

Contractor's NPDES/SWPPP

1.5 CONTRACTOR'S ENVIRONMENTAL MANAGER

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

1.5.1 Duties

The Environmental Manager shall be responsible for the following:

a. Compliance with applicable federal, state, and local environmental regulations, including maintaining required documentation.

b. Implementation of the Waste Management Plan.

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

d. Implementation of the Environmental Protection Plan.

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

f. Monitoring and documentation of environmental procedures.

g. Implementation of mitigation measures indentified in

Environmental Impact Analysis (Armstrong-approved and/or Air Force-approved).

h. Implementation of mitigation measures identified in associated Excavation and Digging permit.

1.5.2 Qualifications

Minimum 5 years construction experience on projects of similar size and scope; minimum 2 years' experience with environmental procedures similar to those of this project; familiarity with environmental regulations applicable to construction operations.

1.6 ENVIRONMENTAL REGULATORY REQUIREMENTS

The Contractor shall be responsible for knowing federal, state, and local regulatory requirements pertaining to legal disposal of all construction and demolition waste materials. Comply with all applicable regulations and maintain records of permits, licenses, certificates, and other environmental regulatory requirement correspondences.

1.7 ENVIRONMENTAL REQUIREMENTS FOR PRODUCTS

1.7.1 Safety Data Sheets (SDS)

Submit an SDS for each product specified in other sections or required by OSHA to have an SDS. SDS shall be prepared within the previous five years . Include information for SDS Sections 1 through 16 in accordance with ANSI Z400.1/Z129.1 and as follows:

a. Section 11: Include data used to determine the hazards cited in Section 3. Identify acute data, carcinogenicity, reproductive effects, and target organ effects. Provide written description of the process used in evaluating chemical hazards relative to preparation of the SDS.

b. Section 12: Include data regarding environmental impacts during raw materials acquisition, manufacture, and use. Include data regarding environmental impacts in the event of an accidental release.

c. Section 13: Include data regarding the proper disposal of the chemical. Include information regarding recycling and reuse. Indicate whether or not the product is considered to be "hazardous waste" according to 40 CFR 261.

d. Section 14: Identify hazard class for shipping.

e. Section 15: Identify federal, state, and local regulations applicable to the material.

f. Section 16: Include additional information relative to recycled content, biobased content, and other information regarding environmental and health impacts. Identify the date SDS was prepared.

1.8 ENVIRONMENTAL PROTECTION PLAN

Prepare and submit an Environmental Protection Plan not less than 10 days

before the preconstruction meeting. At a minimum, address the following elements in accordance with this section and include the information for adhering to requirements identified in the environmental impact analysis.:

a. Identification and contact information for Environmental Manager.

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

c. Summary of environmental management training program.

d. Procedures to address water resources.

e. Procedures to address land resources.

f. Procedures to address air resources.

g. Procedures to address fish and wildlife resources.

h. Monitoring and quality control procedures.

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

1.9 ENVIRONMENTAL DEMONSTRATION AND TRAINING

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

1.9.1 Instructor Qualifications

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

1.9.2 Coordination

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

1.9.3 Training Program

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

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

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

c. Compliance with applicable federal, state, and local environmental regulations.

d. Review of site specific procedures and management plans implemented during construction, including the Waste Management

Plan, Indoor Air Quality (IAQ) Management Plan, Environmental Protection Plan, and procedures for noise and acoustics management.

1.9.3.1 Scheduling

Provide instruction at mutually agreeable time.

1.9.3.2 Training Modules

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

1.9.3.3 Evaluation

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

PART 2 PRODUCTS

2.1 ENVIRONMENTALLY PREFERABLE PRODUCTS

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

2.1.1 Prohibited Materials

The use of the following materials is prohibited:

a. Products containing asbestos.

b. Products containing urea formaldehyde.

c. Products containing polychlorinated biphenyls (PCBs).

d. Products containing chlorinated fluorocarbons.

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

f. Paint containing more than 0.06 percent lead.

2.1.2 Packaging

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

2.1.2.1 Industrial Paperboard

Minimum 45 percent post-consumer recycled content in accordance with ASTM D 5663.

2.1.2.2 Carrier Board

Minimum 10 percent recycled content with a minimum of 10 percent post-consumer recycled content in accordance with ASTM D 5663.

2.1.2.3 Brown Papers

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

2.1.3 Substitutions

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

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

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

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Comply with applicable regulations and these specifications. Preserve the natural resources within the project boundaries and outside the limits of permanent work performed under this Contract in their existing condition or restore to an equivalent or improved condition as approved by the Contracting Officer. Where violation of environmental procedures requirements will irreversibly damage the site, documentation of progress at regular intervals shall be required.

3.1.1 General Disturbance

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

3.1.2 Water Resources

The Contractor's NPDES/SWPPP shall comply with requirements of the NPDES and the applicable State Pollutant Discharge Elimination System (SPDES). In California this is known as the "State Water Pollution Prevention Plan" (SWPPP). Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water. An Industrial Wastewater Discharge Permit shall be obtained from the Environmental Office prior to the release of any materials into drains Contact x2909 for assistance. Store and service construction equipment at areas designated for collection

of oil wastes. Prevent ponding of stagnant water conducive to mosquito breeding habitat. Prevent run-off from site during demolition and construction operations.

3.1.3 Land Resources

Prior to construction, identify land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and landforms without permission from the Contracting Officer. Coordinate protection practices with work specified in Division 2 SITEWORK.

3.1.3.1 Erodible Soils

Plan and conduct earthwork to minimize the duration of exposure of unprotected soils, except where the constructed feature obscures borrow areas, quarries, and waste material areas. Clear areas in reasonably sized increments only as needed to use the areas developed. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.

3.1.3.2 Erosion and Sedimentation Control Devices

Construct or install temporary and permanent erosion and sedimentation control features as required.

3.1.3.3 Tree and Plant Protection

Protect as specified in Division 2 SITEWORK and as specified. Prior to start of construction, tag each tree and plant scheduled to remain. In the event of damage to tree or plant, the Government may, at the Contracting Officer's discretion, deduct the indicated value of the damaged tree or plant from the Contract Sum.

3.1.4 Air Resources

Comply with Indoor Air Quality (IAQ) Management Plan and as follows:

a. Prevent creation of dust, air pollution, and odors.

b. Sequence construction to avoid unnecessary disturbance to site.

c. Use mulch, water sprinkling, temporary enclosures, and other appropriate methods as needed to limit dust and dirt rising and scattering in air. Do not use water when it may create hazardous or other adverse conditions such as flooding and pollution.

d. Store volatile liquids, including fuels and solvents, in closed containers. Do not store with materials that have a high capacity to adsorb VOC emissions or in occupied spaces.

e. Properly maintain equipment to reduce gaseous and particulate pollutant emissions.

3.1.5 Fish and Wildlife Resources

Manage and control construction activities to minimize interference with and damage to wildlife. Do not disturb wildlife. Do not alter water flows or otherwise significantly disturb the native habitat related to the

project and critical to the survival of wildlife, except as indicated or specified.

3.2 FIELD QUALITY CONTROL

Comply with requirements of agencies having jurisdiction and as specified herein. Provide field practices, shipping, and handling of samples in accordance with ASTM D 4840. Provide Field Quality Control Reports in accordance with approved Environmental Protection Plan.

-- End of Section --

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS
08/10

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.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

ACI INTERNATIONAL (ACI)
38800 Country Club Drive
Farmington Hills, MI 48331
Ph: 248-848-3700
Fax: 248-848-3701
E-mail: bkstore@concrete.org
Internet: http://www.concrete.org

ACOUSTICAL SOCIETY OF AMERICA (ASA)
2 Huntington Quadrangle, Suite 1NO1
Melville, NY 11747-4502
Ph: 516-576-2360
Fax: 516-576-2377
E-mail: asa@aip.org
Internet: http://asa.aip.org

ALUMINUM ASSOCIATION (AA)
National Headquarters
1525 Wilson Boulevard, Suite 600
Arlington, VA 22209
Ph: 703-358-2960
Fax: 703-358-2961
Internet: http://www.aluminum.org

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
444 North Capital Street, NW, Suite 249
Washington, DC 20001
Ph: 202-624-5800
Fax: 202-624-5806

E-Mail: info@aashto.org
Internet: http://www.aashto.org

AMERICAN HARDBOARD ASSOCIATION (AHA)
c/o Composite Panel Association
19465 Deerfield Ave., Suite 306
Leesburg, VA 20176
Ph: 703-724-1128
Fax: 703-724-1588
Internet: http://www.pbmdf.org

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
One East Wacker Drive, Suite 700
Chicago, IL 60601-1802
Ph: 312-670-2400
Fax: 312-670-5403
Publications: 800-644-2400
E-mail: pubs@aisc.org
Internet: http://www.aisc.org

AMERICAN IRON AND STEEL INSTITUTE (AISI)
1140 Connecticut Avenue, NW, Suite 705
Washington, DC 20036
Ph: 202-452-7100
Fax: 202-463-6577
E-mail: webmaster@steel.org
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Internet: http://www.naamm.org

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Internet: http://www.nfpa.org

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Internet: http://www.nist.gov

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E-mail: bookshop@oecd.org
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PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not used

-- End of Section --

SECTION 01 45 00.10 40

CONTRACTOR QUALITY CONTROL
02/10

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)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

QC Plan; G

Submit a QC plan within 15 calendar days after receipt of Notice to Proceed (NTP).

1.3 INFORMATION FOR THE CONTRACTING OFFICER (CO)

During construction, report forms to be used include: Contractor Quality Control (CQC) Report, Preparatory Phase Checklist, Initial Phase Checklist, Discrepancy List, and Testing Plan and Log.

Deliver the following to the CO:

a. CQC Report: Original and one copy, by 10:00 AM the next working day after each day that work is performed;

c. Preparatory Phase Checklist: Original attached to the original CQC Report and one copy attached to each copy;

d. Initial Phase Checklist: Original attached to the original CQC Report and one copy attached to each copy;

e. Field Test Reports (per the Testing Plan & Log): One copy, within two working days after the test is performed, attached to the CQC Report;

f. QC Meeting Minutes: One copy, within two working days after the meeting; and

g. QC Certifications: As required by the paragraph entitled "QC Certifications."

1.4 QC PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. The QC program consists of a QC Manager, a QC plan, participation in weekly project meetings, QC meetings, three phases of control, submittal review and approval, testing, and QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this contract. The QC program shall cover on-site and off-site work and shall be keyed to the work sequence. No work or testing may be performed unless the QC Manager is on the work site.

1.4.1 Preliminary Work Authorized Prior to Acceptance

The only work that is authorized to proceed prior to the acceptance of the QC plan is mobilization of storage and office trailers, temporary utilities, and surveying.

1.4.2 Acceptance

Acceptance of the QC plan is required prior to the start of construction. The CO reserves the right to require changes in the QC plan and operations as necessary, including removal of personnel, to ensure the specified quality of work. The CO reserves the right to interview any member of the QC organization at any time in order to verify the submitted qualifications.

1.4.3 Notification of Changes

Notify the CO, in writing, of any proposed change, including changes in the QC organization personnel, a minimum of seven calendar days prior to a proposed change. Proposed changes shall be subject to the acceptance by the CO.

1.5 QC ORGANIZATION

1.5.1 QC Manager

1.5.1.1 Duties

Provide a QC Manager at the work site to implement and manage the QC program. In addition to implementing and managing the QC program, the QC Manager may perform the duties of project superintendent. The QC Manager is required to attend the weekly project meetings, conduct the QC meetings, perform the three phases of control, perform submittal review and approval, ensure testing is performed and provide QC certifications and documentation required in this contract. The QC Manager is responsible for managing and coordinating the three phases of control and documentation performed by others.

1.5.1.2 Qualifications

An individual with a minimum of 5 years combined experience as a superintendent, inspector, QC Manager, project manager, or construction manager on similar size and type construction contracts which included the major trades that are part of this contract. The individual must be familiar with the requirements of the EM 385-1-1 and have experience in the areas of hazard identification and safety compliance.

1.5.1.3 Construction Quality Management Training

In addition to the above experience and education requirements, the QC Manager shall have completed the US Army Corps of Engineers course "Construction Quality Management for Contractors" and will have a current certificate.

1.5.2 Alternate QC Manager Duties and Qualifications

Designate an alternate for the QC Manager to serve in the event of the designated QC Manager's absence. The period of absence may not exceed two weeks at one time, and not more than 30 workdays during a calendar year. The qualification requirements for the Alternate QC Manager shall be the same as for the QC Manager.

1.6 QC PLAN

1.6.1 Requirements

Provide, for acceptance by the CO, a QC plan submitted in a three-ring binder that covers both on-site and off-site work and includes the following with a table of contents listing the major sections identified with tabs.

I. QC ORGANIZATION: A chart showing the QC organizational structure and its relationship to the production side of the organization.

II. NAMES AND QUALIFICATIONS: In resume format, for each person in the QC organization. Include the CQM for Contractors course certification required by the paragraph entitled "Construction Quality Management Training".

III. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONAL: Of each person in the QC organization.

IV. OUTSIDE ORGANIZATIONS: A listing of outside organizations such as consulting engineering firms that will be employed by the Contractor and a description of the services these firms will provide.

V. APPOINTMENT LETTERS: Letters signed by an officer of the firm appointing the QC Manager and Alternate QC Manager and stating that they are responsible for managing and implementing the QC program as described in this contract. Include in this letter the QC Manager's authority to direct the removal and replacement of non-conforming work.

VI. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER: Procedures for reviewing, approving and managing submittals. Provide the name(s) of the person(s) in the QC organization authorized to review and certify submittals prior to approval.

VII. TESTING LABORATORY INFORMATION: Testing laboratory information required by the paragraphs "Accredited Laboratories" or "Testing Laboratory Requirements", as applicable.

VIII. TESTING PLAN AND LOG: A Testing Plan and Log that includes the tests required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for

each test.

IX. PROCEDURES TO COMPLETE DISCREPANCY LIST: Procedures to identify, record, track and complete discrepancies.

X. DOCUMENTATION PROCEDURES: Use Government formats.

XI. LIST OF DEFINABLE FEATURES OF WORK: A Definable Feature of Work (DFOW) is a task, which is separate and distinct from other tasks, has the same control requirements and work crews. The list shall be cross-referenced to the Contractor's Construction Schedule and the specification sections. For projects requiring a Progress Chart, the list of definable features of work shall include but not be limited to all items of work on the schedule.

XII. PROCEDURES FOR PERFORMING THREE PHASES OF CONTROL: For each DFOW provide Preparatory and Initial Phase Checklists. Each list shall include a breakdown of quality checks that will be used when performing the quality control functions, inspections, and tests required by the contract documents. The preparatory and initial phases shall be conducted with a view towards obtaining quality construction by planning ahead and identifying potential problems.

XIII. PROCEDURES FOR COMPLETION INSPECTION: See the paragraph entitled "COMPLETION INSPECTIONS".

1.7 QC MEETINGS

After the start of construction, during the weekly project meetings Quality Control shall be addressed at the work site with the superintendent, QC Manager and the foreman responsible for the ongoing and upcoming work. The Contractor shall prepare the minutes of the meeting and provide a copy to the CO within two working days after the meeting. As a minimum, the following shall be accomplished at each meeting:

a. Review the minutes of the previous meeting;

b. Review the schedule and the status of work and rework;

c. Review the status of submittals;

d. Review the work to be accomplished in the next two weeks and documentation required;

e. Resolve QC and production problems (RFIs, etc.);

f. Address items that may require revising the QC plan; and

g. Review Accident Prevention Plan (APP).

1.8 THREE PHASES OF CONTROL

The three phases of control shall adequately cover both on-site and off-site work and shall include the following for each DFOW.

1.8.1 Preparatory Phase

Notify the CO at least five work days in advance of each preparatory phase. Conduct the preparatory phase with the superintendent and the

foreman responsible for the definable feature of work. Document the results of the preparatory phase actions in the daily CQC Report and in the QC checklist. Perform the following prior to beginning work on each definable feature of work:

a. Review each paragraph of the applicable specification sections;

b. Review the contract drawings;

c. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required;

d. Review the testing plan and ensure that provisions have been made to provide the required QC testing;

e. Examine the work area to ensure that the required preliminary work has been completed;

f. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data;

g. Review the APP and appropriate Activity Hazard Analysis (AHA) to ensure that applicable safety requirements are met, and that required Safety Data Sheets (SDS), formerly Material Safety Data Sheets (MSDS), are submitted; and

h. Discuss specific controls used and the construction methods and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each DFOW.

1.8.2 Initial Phase

Notify the CO at least five work days in advance of each initial phase. When construction crews are ready to start work on a DFOW, conduct the Initial Phase with the foreman responsible for that DFOW. Observe the initial segment of the work to ensure that it complies with contract requirements. Document the results of the Initial Phase in the daily CQC Report and in the QC checklist. Perform the following for each DFOW:

a. Establish the quality of workmanship required;

b. Resolve conflicts;

c. Ensure that testing is performed by the approved laboratory; and

d. Check work procedures for compliance with the APP and the appropriate AHA to ensure that applicable safety requirements are met.

1.8.3 Follow-Up Phase

Perform the following for on-going work daily, or more frequently as necessary, until the completion of each DFOW and document in the daily CQC Report and in the QC checklist:

a. Ensure the work is in compliance with contract requirements;

b. Maintain the quality of workmanship required;

c. Ensure that testing is performed by the approved laboratory;

d. Ensure that discrepancies are being corrected; and

e. Assure manufacturers' representatives have performed necessary inspections, if required.

1.8.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same DFOW if the quality of on-going work is unacceptable, if there are changes in the applicable QC organization, if there are changes in the on-site production supervision or work crew, if work on a DFOW is resumed after substantial period of inactivity, or if other problems develop.

1.8.5 Notification of Three Phases of Control for Off-Site Work

Notify the CO at least two weeks prior to the start of the preparatory and initial phases.

1.9 SUBMITTAL REVIEW AND APPROVAL

Procedures for submission, review, and approval of submittals are described in the submittal section of the specification.

1.10 TESTING

Except as stated otherwise in the specification sections, perform sampling and testing required under this contract.

1.10.1 Accreditation Requirements

Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e.; E 329, C 1077, D 3666, D 3740, A 880, E 543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."

1.10.2 Laboratory Accreditation Authorities

Laboratory Accreditation Authorities include the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology, the American Association of State Highway and Transportation Officials (AASHTO), International Accreditation Services, Inc. (IAS), U. S. Army Corps of Engineers Materials Testing Center (MTC), and the American Association for Laboratory Accreditation (A2LA).

1.10.3 Capability Check

The CO retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set

forth in this contract.

1.10.4 Test Results

Cite applicable Contract requirements, tests or analytical procedures used. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify the CO immediately. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. Test results shall be signed by a testing laboratory representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the CO.

1.11 QC CERTIFICATIONS

1.11.1 Contractor Quality Control Report Certification

Each CQC Report shall contain the following statement: "On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge except as noted in this report."

1.11.2 Completion Certification

Upon completion of work under this contract, the QC Manager shall furnish a certificate to the CO attesting that "the work has been completed, inspected, tested and is in compliance with the contract."

1.12 COMPLETION INSPECTIONS

1.12.1 GOVERNMENT INSPECTION

Government in-process and end-item inspections will be performed at the construction site and at the Contractor's and/or subcontractor(s)' facilities by a designated Government representative to assure compliance with the contract requirements, drawings, and technical specifications. The extent of such inspection will depend upon the level of quality and workmanship of the items. The Contractor shall notify the Contracting Officer of scheduled inspections a minimum of 48 hours prior to such scheduled inspections.

The Contractor shall give 24-hour advance notice to the Contracting Officer of the date when the contract work will begin at the site to allow coordination with the inspection staff. Should the Contractor unexpectedly suspend work at any time prior to completion of the contract, the Contractor shall notify the Contracting Officer as soon as possible. If work is suspended for 3 days or longer, the Contractor shall not resume work without notifying the Contracting Officer 24-hours in advance.

1.12.2 Discrepancy List Inspection

Near the completion of all work or any increment thereof the CQC Manager shall conduct an inspection of the work and develop a Discrepancy List of items which do not conform to the approved drawings and specifications. The discrepancy list shall include the estimated date by which the deficiencies will be corrected. A copy of the Discrepancy List shall be provided to the Government. The CQC Manager or staff shall make follow-on inspections to

ascertain that all deficiencies have been corrected. The Contractor shall then notify the Government that the facility is ready for the Government inspection.

1.12.3 Pre-Final Inspection

The QC manager will perform this inspection to verify that the facility is complete and ready to be occupied. The QC Manager shall ensure that all items on this Discrepancy List are corrected prior to notifying the Government that a "Final" inspection with the customer can be scheduled.

1.12.4 Final Acceptance Inspection

The QC Manager, the superintendent, or other Contractor management personnel, COR and the CO will be in attendance at this inspection. Additional Government personnel may be in attendance. Notice shall be given by the CO at least 14 days prior to the Final Punch List inspection. The Final Punch List inspection will be formally scheduled by the CO. The notice shall state that all specific items previously identified to the Contractor as being unacceptable will be complete by the date scheduled for the Final Punch List inspection.

1.13 DOCUMENTATION

Maintain current and complete records of on-site and off-site QC program operations and activities. The forms identified under the paragraph "INFORMATION FOR THE CONTRACTING OFFICER (CO)" shall be used. Reports are required for each day work is performed. Account for each calendar day throughout the life of the contract. The superintendent and the QC Manager must prepare and sign the Contractor Production and CQC Reports, respectively. The reporting of work shall be identified by terminology consistent with the construction schedule. In the "remarks" section in this report which will contain pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site. For each remark given, identify the Schedule Activity No. that is associated with the remark.

1.13.1 Quality Control Validation

Establish and maintain the following in a series of three ring binders. Binders shall be divided and tabbed as shown below. These binders shall be readily available to the Government's Quality Assurance Team during all business hours.

a. All completed Preparatory and Initial Phase Checklists, arranged by specification section.

b. All milestone inspections, arranged by Activity/Event Number.

c. A current up-to-date copy of the Testing and Plan Log with supporting field test reports, arranged by specification section.

d. Copies of all contract modifications, arranged in numerical order. Also include documentation that the modified work was accomplished.

e. A current up-to-date copy of the Discrepancy List, corrective action plan, and documentation of corrections made to defective work.

f. Maintain up-to-date copies of all punch lists issued by the QC Staff on the Contractor and Sub-Contractors and all punch lists issued by the Government.

1.13.2 As-Built Drawings

The QC Manager shall review the as-built drawings, as required in Section 01 78 00 CLOSEOUT SUBMITTALS, to ensure they are kept current on a daily basis and marked to show deviations from the Contract drawings. Ensure each deviation has been identified with the appropriate modifying documentation (e.g. modification number, RFI number, etc.). The QC Manager shall initial each deviation or revision that was approved by the CO. Upon completion of work, the QC Manager shall submit a certificate attesting to the accuracy of the as-built drawings prior to submission to the CO.

The Contractor shall maintain at the jobsite two working sets of full-size prints of the contract drawings, accurately marked in red with adequate dimensions, to show all variations between the construction actually provided and that indicated or specified in the contract documents, including buried or concealed construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the contract drawings. Existing utility lines and features revealed during the course of construction shall also be accurately located and dimensioned. Variations in the interior utility systems shall be clearly defined and dimensioned; and coordinated with exterior utility connections at the building five-foot line, where applicable. Existing topographic features which differ from those shown on the contract drawings shall also be accurately located and recorded. Where a choice of materials or methods is permitted herein, or where variations in scope or character of methods is permitted herein, or where variations in scope or character of work from that of the original contract are authorized, the drawings shall be marked to define the construction actually provided. The representations of such changes shall conform to standard drafting practice and shall include such supplementary notes, legends, and details as necessary to clearly portray the as-built construction.

These drawings shall be available for review by the Contracting Officer at all times. Upon completion of the work, both sets of the marked up prints shall be certified as correct, signed by the Contractor, and delivered to the Contracting Officer for his approval before project acceptance.

1.14 NOTIFICATION OF NON-COMPLIANCE

The CO will notify the Contractor of any detected non-compliance with the foregoing requirements. The Contractor shall take immediate corrective action. If the contractor fails or refuses to correct the non-compliant work, the CO will issue a non-compliance notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the CO may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall make no part of the time lost due to such stop orders the subject of claim

for extension of time, for excess costs, or damages.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 50 00

TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS
08/09

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component of, each section of the specifications.

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 WATER WORKS ASSOCIATION (AWWA)

AWWA C511	(2007) Standard for Reduced-Pressure Principle Backflow Prevention Assembly

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR List	(continuously updated) List of Approved Backflow Prevention Assemblies
FCCCHR Manual	(1988e9) Manual of Cross-Connection Control

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241	(2009) Standard for Safeguarding Construction,Alteration, and Demolition Operations
NFPA 70	(2014) National Electrical Code

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(2007; Rev K) Obstruction Marking and Lighting

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD	(2000) Manual of Uniform Traffic Control Devices

1.3 SUBMITTALS

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

SD-01 Preconstruction Submittals

Construction site plan; G

Traffic control plan; G

SD-06 Test Reports

Backflow Preventer Tests

SD-07 Certificates

Backflow Tester Certification

Backflow Preventers Certificate of Full Approval

1.4 CONSTRUCTION SITE PLAN

Prior to the start of work, the Contractor shall submit a site plan showing the locations and dimensions of temporary facilities (including layouts and details, equipment and material storage area onsite and offsite, and access and haul routes, avenues of ingress/egress to the fenced area and details of the fence installation). Identify any areas which may have to be graveled to prevent the tracking of mud. Indicate if the use of a supplemental or other staging area is desired. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

1.5 BACKFLOW PREVENTERS CERTIFICATE

Certificate of Full Approval from FCCCHR List, University of Southern California, attesting that the design, size and make of each backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. Certificate of Provisional Approval will not be acceptable.

1.5.1 Backflow Tester Certificate

Prior to testing, submit to the Contracting Officer certification issued by the State or local regulatory agency attesting that the backflow tester has successfully completed a certification course sponsored by the regulatory agency. Tester must not be affiliated with any company participating in any other phase of this Contract.

1.5.2 Backflow Prevention Training Certificate

Submit a certificate recognized by the State or local authority that states the installer has completed at least 10 hours of training in backflow preventer installations. The certificate must be current.

1.5.3 Backflow Preventers

Reduced pressure principle type conforming to the applicable requirements AWWA C511. The particular make, model/design, and size of backflow preventers to be installed must be included in the latest edition of the List of Approved Backflow Prevention Assemblies issued by the FCCCHR List and be accompanied by a Certificate of Full Approval from FCCCHR List. After installation conduct Backflow Preventer Tests and provide test reports verifying that the installation meets the FCCCHR Manual Standards.

PART 2 PRODUCTS

2.1 TEMPORARY SIGNAGE

2.1.1 Bulletin Board

Immediately upon beginning of work, provide a weatherproof bulletin board for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer.

2.1.2 Project and Safety Signs

The requirements for the signs, their content, and location are as shown on the drawings. Erect signs within 15 days after receipt of the notice to proceed. Correct the data required by the safety sign daily, with light colored metallic or non-metallic numerals.

2.2 TEMPORARY TRAFFIC CONTROL

2.2.1 Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic barricades will be required. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

2.2.2 Fencing

Provide fencing along the construction site, and at all open excavations and tunnels to control access by unauthorized people. Fencing must be installed to meet or exceed OSHA requirements according to application.

2.2.3 Temporary Wiring

Provide temporary wiring in accordance with NFPA 241 and NFPA 70. Include frequent inspection of all equipment and apparatus.

PART 3 EXECUTION

3.1 EMPLOYEE PARKING

Contractor employees will park privately owned vehicles in an area designated by the Contracting Officer. This area will be within reasonable walking distance of the construction site. Contractor employee parking must not interfere with existing and established parking requirements of the government installation.

3.2 AVAILABILITY AND USE OF UTILITY SERVICES

3.2.1 Temporary Utilities

Contractor shall provide temporary utilities required for construction. Materials may be new or used, shall be adequate for the required usage,

shall not create unsafe conditions, and shall not violate applicable codes and standards.

3.2.1.1 Electricity

The NASA Armstrong electrical distribution system typically has 208/120 volt three phase four wire or 480/277 volt three phase four wire or 480 volt three phase three wire available for temporary power connections. Temporary electrical service to support the construction activities is available based on location and expected load from the Contractor. Contractor shall supply and install all necessary equipment for temporary service, including, but not limited to, transformers, circuit breakers, conduit, wire, boxes, receptacles, supports, safety disconnects, fuses and power cords. Should the required electrical system not be in the immediate construction vicinity, the Contractor shall make provisions for supplying their own power.

All plans for temporary electrical installations and modifications to support construction activities will be submitted for review and approval prior to connection; and such activities will be subject to NASA Armstrong Utility Outage requirements (see Section 01 35 14.11 40, paragraph "PERMIT REQUIRED OPERATIONS"). Existing electrical systems utilized by the Contractor for temporary service shall be left in a code compliant manner at the end of the construction activity.

3.2.1.2 Water

Contractor shall make connections to existing facilities to provide water for construction purposes. Water used will be furnished by the Government.

3.2.1.3 Telephone Service

The Contractor shall provide telephone service for Contractor use. The Contractor shall pay costs of service. The Contractor shall coordinate with the Contracting Officer who will coordinate with NASA/AFRC telecommunications to allow system coordination for emergency 911 services.

3.2.2 Sanitation

Provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Obtain approval from the system owner prior to discharge into any municipal, district, or commercial sanitary sewer system. Any penalties and / or fines associated with improper discharge will be the responsibility of the Contractor. Coordinate with the Contracting Officer and follow station regulations and procedures when discharging into the station sanitary sewer system. Maintain these conveniences at all times without nuisance. In addition, the Contractor may also use existing sanitary facilities during the construction period.

3.2.3 Obstruction Lighting of Cranes

Provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet above ground level. Light construction and installation must comply with FAA AC 70/7460-1. Lights must be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer.

3.2.4 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.

3.3 TRAFFIC PROVISIONS

3.3.1 Maintenance of Traffic

a. Conduct operations in a manner that will not close any thoroughfare or interfere in any way with traffic except with written permission of the Contracting Officer at least 15 calendar days prior to the proposed modification date, and provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval. The plan must be in accordance with State and local regulations and the MUTCD, Part VI. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.

b. Conduct work so as to minimize obstruction of traffic, and maintain traffic on at least half of the roadway width at all times. Obtain approval from the Contracting Officer prior to starting any activity that will obstruct traffic.

c. Provide, erect, and maintain, at contractors expense, lights, barriers, signals, passageways, detours, and other items, that may be required by the Life Safety Signage, overhead protection authority having jurisdiction.

3.3.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Provide and maintain, at Contractor's own expense, measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of adequate warning, danger, and direction signs, as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of any damage to roads caused by construction operations.

3.3.3 Dust Control

The Contractor shall provide dust control in accordance with Section 01 35 14.11 40 "AFRC Safety Requirements."

3.4 CONTRACTOR'S TEMPORARY FACILITIES

3.4.1 TEMPORARY STRUCTURES

Contractor-owned or leased trailers and temporary structures, where telephone service is installed and connected to the 911 emergency system, shall be identified by Government assigned numbers. The required building number shall be displayed on the structure on signs having brilliant blue background, white numbers, and of dimensions 18 inches by 36 inches. The

signs shall be displayed on two sides of the structure at the upper left corner. The Contractor shall apply the number to the trailers within 14 days of placement, or sooner, if directed by the Government.

3.4.2 Safety

Protect the integrity of any installed safety systems or personnel safety devices. If entrance into systems serving safety devices is required, the Contractor must obtain prior approval from the Contracting Officer. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and obtain approval from the Contracting Officer.

3.4.3 Administrative Field Offices

Provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

3.4.4 Storage Area

Construct a view-obstructing temporary 6 foot high chain link fence around trailers and materials. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Do not place or store trailers, materials, or equipment outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Contracting Officer away from the vicinity of the construction site but within the installation boundaries. Trailers, equipment, or materials must not be open to public view with the exception of those items which are in support of ongoing work on any given day. Do not stockpile materials outside the fence in preparation for the next day's work. Park mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment within the fenced area at the end of each work day.

3.4.5 Appearance of Trailers

a. Trailers utilized by the Contractor for administrative or material storage purposes must present a clean and neat exterior appearance and be in a state of good repair. Trailers which, in the opinion of the Contracting Officer, require exterior painting or maintenance will not be allowed on installation property.

b. Paint using suitable paint and maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal.

3.4.6 Maintenance of Storage Area

a. Keep fencing in a state of good repair and proper alignment. Grassed or unpaved areas, which are not established roadways, will be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles; gravel gradation will be at the Contractor's discretion.

3.4.7 Security Provisions

Provide adequate outside security lighting at the Contractor's temporary facilities. The Contractor will be responsible for the security of its own

equipment; in addition, the Contractor will notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

3.4.8 Weather Protection of Temporary Facilities and Stored Materials

Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment in the building from damage.

3.5 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, furnish and erect temporary project safety fencing at the work site. Maintain the safety fencing during the life of the contract and, upon completion and acceptance of the work, will become the property of the Contractor and be removed from the work site.

3.6 CLEANUP

Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store within the fenced area described above or at the supplemental storage area any materials resulting from demolition activities which are salvageable. Neatly stack stored materials not in trailers, whether new or salvaged.

3.7 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletin board, signs, barricades, haul roads, and any other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence that will become the property of the Contractor. Restore to the original or better condition, areas used by the Contractor for the storage of equipment or material, or other use. Gravel used to traverse grassed areas must be removed and the area restored to its original condition, including top soil and seeding as necessary.

-- End of Section --

SECTION 01 74 19

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT
01/07

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 1609	(2001) Development and Implementation of a Pollution Prevention Program

1.2 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. A minimum of 50 percent by weight of total project solid waste shall be diverted from the landfill in support of EO 13514, Section 2 and NASA Procedural Requirements (NPR) 8530.1.

1.3 MANAGEMENT

Develop and implement a waste management program in accordance with ASTM E 1609 and as specified. Take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor is responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling accrue to the Contractor. Appropriately permit firms and facilities used for recycling, reuse, and disposal for the intended use to the extent required by federal, state, and local regulations. Also, provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Waste Management Plan; G

SD-11 Closeout Submittals

Records

Salvage Material Records shall be submitted in accordance with Paragraph "SALVAGE MATERIALS AND EQUIPMENT"

1.5 MEETINGS

Conduct Construction Waste Management meetings. After award of the Contract and prior to commencement of work, schedule and conduct a meeting with the Contracting Officer to discuss the proposed Waste Management Plan and to develop a mutual understanding relative to the details of waste management. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting outlined in Section 01 45 00.10 40 CONTRACTOR QUALITY CONTROL. At a minimum, environmental and waste management goals and issues shall be discussed at the following additional meetings:

a. Pre-bid meeting.

b. Preconstruction meeting.

c. Regular on-site QC meetings.

d. Work safety meetings.

1.6 WASTE MANAGEMENT PLAN

A waste management plan shall be submitted within 15 days after notice to proceed and not less than 10 days before the preconstruction meeting. The plan shall demonstrate how the project waste diversion goal shall be met and shall include the following:

a. Name of individuals on the Contractor's staff responsible for waste prevention and management.

b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.

c. Description of the regular meetings to be held to address waste management.

d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.

e. Characterization, including estimated types and quantities, of the waste to be generated.

f. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on

the project.

g. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity. Include the name, location, and phone number for each reuse facility to be used, and provide a copy of the permit or license for each facility.

h. List of specific waste materials that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Recycling facilities that will be used shall be identified by name, location, and phone number, including a copy of the permit or license for each facility.

i. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by the Contracting Officer.

j. Description of the means by which any waste materials identified in item (h) above will be protected from contamination.

k. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).

l. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

Revise and resubmit Plan as required by the Contracting Officer. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. Distribute copies of the Waste Management Plan to each subcontractor, the Quality Control Manager, and the Contracting Officer.

1.7 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. The records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction.

1.8 SALVAGE MATERIALS AND EQUIPMENT

All items of materials designated by the Contracting Officer to be salvaged shall remain the property of the Government. Salvage Material Records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction. Salvage items shall be marked, segregated, itemized, delivered, and off-loaded by the Contractor at the storage area near Building 4876.

The Contractor shall maintain adequate property control records for all materials or equipment designated as salvage. These records may be in

accordance with the Contractor's system of property control, if approved by the Contracting Officer. The Contractor shall be responsible for adequate storage and protection of salvaged materials and equipment and shall replace, at no cost to the Government, salvage materials and equipment broken or damaged during salvage operations.

1.9 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvageability of identified materials. Provide the necessary containers, bins and storage areas to facilitate effective waste management and clearly and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations and coordinate with Section 01 35 14.11 40 AFRC SAFETY REQUIREMENTS.

Separate materials by one of the following methods:

1.9.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted as described below into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the following category types as appropriate to the project waste and to the available recycling and reuse programs in the project area:

a. Land clearing debris.

b. Asphalt.

c. Concrete and masonry.

d. Metal (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, lead brass, bronze).

   (1) Ferrous.

   (2) Non-ferrous.

e. Wood (nails and staples allowed).

f. Debris.

g. Glass (colored glass allowed).

h. Paper.

(1) Bond.

(2) Newsprint.

(3) Cardboard and paper packaging materials.

i. Plastic.

(1) Type 1: Polyethylene Terephthalate (PET, PETE).

(2) Type 2: High Density Polyethylene (HDPE).

(3) Type 3: Vinyl (Polyvinyl Chloride or PVC).

(4) Type 4: Low Density Polyethylene (LDPE).

(5) Type 5: Polypropylene (PP).

(6) Type 6: Polystyrene (PS).

(7) Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

j. Gypsum.

k. Non-hazardous paint and paint cans.

l. Carpet.

m. Ceiling tiles.

n. Insulation.

o. Beverage containers.

1.9.2 Commingled Method.

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

1.9.3 Other Methods.

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.10 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the Contracting Officer and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.10.1 Reuse.

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Coordinate reuse with the Contracting Officer. Sale or donation of waste suitable for reuse shall be considered.

1.10.2 Recycle.

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling. All fluorescent lamps, HID lamps, and mercury-containing thermostats removed from the site shall be recycled. Arrange for timely pickups from the site or deliveries to recycling facilities in order to prevent contamination of recyclable materials.

1.10.3 Waste.

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

1.10.4 Return

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

SECTION 01 75 00.00 40

AFRC STARTUP AND COMMISSIONING
10/06

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 SUBMITTALS

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

SD-01 Preconstruction Submittals

Verification of Prior Experience; G and expertise with similar project scope

Documentation of Manufacturer's Prior Experience; G and expertise with similar project materials and systems

Quality Control Plan; G including testing and start-up schedule

Manufacturer's Sample Warranty and Operation and Maintenance Data; G

Provide Evidence that products used within this specification are manufactured in the United States.

SD-02 Shop Drawings

Drawings, Diagrams and Schedules; G specifically prepared to illustrate some portion of the work

Diagrams and Instructions; G 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; G prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated

SD-03 Product Data

Catalog cuts; G, 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; G when the contract requires product warranties

SD-05 Design Data

Design Calculations; G, mix designs, analyses or other data

pertaining to a part of work

SD-06 Test Reports

Factory Tests; G
Functional Field Test; G
Final Acceptance Test; G

Test Procedures; G

SD-07 Certificates

Qualification of Manufacturer; G

Qualification of Installer

Certify that the installer meets requirements specified under paragraph entitled "Qualification of Installer."

SD-08 Manufacturer's Instructions

Manufacturer's Administrative Requirements; G

Demonstration and Training Information; G

Manufacturer's Procedural Requirements; G for initial checkout, startup, and adjusting to ensure safe operation during acceptance testing and commissioning.

SD-09 Manufacturer's Field Reports

Documentation of the Testing and Verification Actions; G taken by manufacturer's representative at the job site, or on a sample taken from the job site, on a portion of the work, during installation, to confirm compliance with manufacturer's standards or instructions

SD-10 Operation and Maintenance Data

Refer to Section 01 78 23 OPERATION AND MAINTENANCE DATA for detailed requirements and procedures.

Operation and Maintenance Data provided by the manufacturer to ensure the safe and efficient operation, maintenance and repair of the system or equipment provided.

Safety and Security Data or Posters provided by the manufacturer

1.2.1 Preconstruction and Pre-Testing Requirements

The Contractor is responsible to deliver equipment and services to meet the requirements and specifications of their respective contract. All equipment must be free of latent manufacturing and installation defects. Acceptance criteria must be clearly defined to establish required baselines for future maintenance and life-cycle evaluations. The Government reserves the option to elect performance of acceptance testing by internal personnel, or a designated third party. Regardless of who performs the acceptance testing, the requirements of acceptance must be met by the Contractor.

Submit the following for review and approval prior to the commencement of work and any testing, whether such testing is on site or elsewhere:

a. Verification of prior experience and expertise with similar project scope

b. Documentation of manufacturer's prior experience and expertise with similar project materials and systems

c. Quality control plan

d. Manufacturer's Sample Warranty and Operation and Maintenance Data, with details regarding start-up procedures

e. Manufacturer's administrative requirements

f. Manufacturer's procedural requirements

g. Demonstration and Training Information

Contractor must submit the following certifications:

a. Provide evidence that products used within this specification are manufactured in the United States.

b. Qualification of Manufacturer, including current licenses and insurance.

c. Qualification of Installer, including licenses and insurance.

1.2.2 Shop Drawings and Diagrams

Submit the following shop drawings, record drawings, and diagrams as required to correctly execute the installation of the work:

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

b. 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

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

1.2.3 Product and Design Data

Contractor must submit all product data and any design calculations, mix designs, analyses or other data pertaining to a part of work to ensure a complete functional installation; including, but not limited to:

a. 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

b. Samples of warranty language when the contract requiresproduct warranties

c. Operation and Maintenance Data provided by the manufacturer to ensure the safe and efficient operation, maintenance and repair of the system or equipment provided.

d. Safety and Security Data or posters provided by the manufacturer to be posted in a conspicuous visible location for operational and maintenance personnel.

1.2.4 Tests Required

Perform tests to verify proper functioning of fire protection, fire suppression, HVAC, compressed air, electrical switchgear, protective relaying, fluid and gas systems, pump/motor combinations, boiler systems, hydraulic and pneumatic control, condition/performance monitoring systems, energy control and monitoring systems, and other assemblies and components that need to be tested as an interrelated whole.

1.2.4.1 STARTING OF SYSTEMS

The Contractor shall perform formal functional tests with full documentation using the approved recording form. Test procedures and recording form that document the test steps shall be submitted for approval to the Contracting Officer twenty one (21) calendar days prior to the proposed test date. The procedure shall consist of step by step instruction to verify system parameters, components, and functions.

The Contractor shall perform an "in-house" test to verify that the system and components have been properly installed and are functioning properly. Test shall be performed in the presence of the Contracting Officer. Test shall be completed and found acceptable when one full test has been performed without component or system malfunction. The contractor shall submit a Functional Test Report documenting the actual steps and results of the test.

1.2.4.2 Factory Tests

Submit certified copies of required tests performed at the factory to verify proper build. These test results will be used in the "Final Acceptance Test" section to verify no shipping damage and proper installation. Government may request to witness Factory Test prior to shipping, Contractor shall give minimum 14 calendar days advance notice to permit Government travel time.

1.2.4.3 Functional Field Test

Contractor must perform functional field test(s) to verify that the system and components have been properly installed and are functioning properly. Perform test(s) in the presence of the Contracting Officer. Acceptance will be issued when system has performed per other sections and referenced industry standards.

Coordinate and submit documentation of the testing and verification actions taken by manufacturer's representative at the job site, or on a sample taken from the job site, on a portion of the work, during installation, to confirm compliance with manufacturer's standards or instructions.

1.2.4.4 Final Acceptance Test

Perform a formal test with full documentation using the approved recording

form. Contracting Officer will witness this test and issue a written final acceptance. Provide final test data to the Contracting Officer with a cover letter clearly marked with the system name, date, and the words "Final Test Data - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

1.2.4.5 Test Procedures

Submit test procedure and recording forms that document the test steps for approval to the Contracting Officer 30 calendar days prior to the proposed test date. Procedure must clearly state step by step instruction to verify system parameters, components, and functions.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 78 00

CLOSEOUT SUBMITTALS
05/10

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

GREEN SEAL (GS)

GS-37	(2000; R 2009) Industrial and Institutional Cleaners

1.2 SUBMITTALS

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

SD-03 Product Data

As-Built Record of Equipment and Materials
Warranty Management Plan
Warranty Tags
Final Cleaning
Spare Parts Data

SD-08 Manufacturer's Instructions

Preventive Maintenance schedule and instructions
Condition Monitoring (Predictive Testing) schedule and instructions
Inspection schedule and instructions
Instructions to be Posted

SD-10 Operation and Maintenance Data

Equipment-in-Place List
Operation and Maintenance Manuals

SD-11 Closeout Submittals

As-Built Drawings
Certification of EPA Designated Items; G
NASA Form NF1046

1.3 PROJECT RECORD DOCUMENTS

1.3.1 As-Built Drawings

Drawings showing final as-built conditions of the project. This paragraph covers complete record drawings, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working record drawings," "as-built drawings" and "final record drawings" refer to contract drawings which are revised to be used for final record drawings showing as-built conditions. The red-lined drawings must consist of 2 sets of completed final as-built original drawings, and the approved deviation documentation.

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 execution 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. 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 depth below the surface of each run. In addition, a GPS survey shall be completed by Contractor when required by contract drawings.

b. The location and dimensions of any changes within the building structure.

c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

d. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

f. Changes or modifications which result from the final inspection.

g. Where contract drawings or specifications present options, show only the option selected for construction on the final as-built prints.

h. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, furnish a contour map of the final borrow pit/spoil area elevations.

i. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

j. Modifications (include within change order price the cost to change working and final record drawings to reflect modifications) and compliance with the following procedures.

(1) Follow directions in the modification for posting descriptive changes.

(2) Place a Modification Delta at the location of each deletion.

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

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

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

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

(7) The Modification Delta shall be a triangle 1/2 inch in size unless the area where the delta is to be placed is crowded. Smaller size delta shall be used for crowded areas.

1.3.1.2 Drawing Preparation

Modify the record drawings as needed to correctly show the features of the project as 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.

1.3.1.3 Payment

No separate payment will be made for record drawings required under this contract, and all costs accrued in connection with such drawings are considered a subsidiary obligation of the Contractor.

1.3.2 As-Built Record of Equipment and Materials

Furnish two (2) copies of preliminary record of equipment and materials used on the project 15 days prior to final inspection, including NASA tagged collateral equipment uninstalled or removed from the site. NASA tagged collateral equipment typically has a label with a NASA logo, a

barcoded asset number, building number, and description. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Submit two (2) 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. At a minimum, list the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA

Description, and asset tag number if available	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), date installed, equipment cost, model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, estimated service life, 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

Submit two copies of the Spare Parts Data list.

a. Indicate manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

b. The Government will identify what equipment for which to provide spare parts and the number of spare parts to provide. Supply this number of items of each part for spare parts inventory as requested by the Government. Provision of spare parts does not relieve the Contractor of responsibilities listed under the contract guarantee provisions.

1.5 PREVENTIVE MAINTENANCE

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

a. Define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation

procedure permitting the record operation capability requirements within the schedule. Provide a signoff blank for the Contractor and 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 preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.6 CERTIFICATION OF EPA DESIGNATED ITEMS

Submit the Certification of EPA Designated Items as required by FAR 52.223-9, "Certification and Estimate of Percentage of Recovered Material Content for EPA Designated Items". Include on the certification form the following information: project name, project number, Contractor name, license number, Contractor address, and certification. The certification will read as follows and be signed and dated by the Contractor. "I hereby certify the information provided herein is accurate and that the requisition/procurement of all materials listed on this form comply with current EPA standards for recycled/recovered materials content. The following exemptions may apply to the non-procurement of recycled/recovered content materials: 1) The product does not meet appropriate performance standards; 2) The product is not available within a reasonable time frame; 3) The product is not available competitively (from two or more sources); 4) The product is only available at an unreasonable price (compared with a comparable non-recycled content product)." Record each product used in the project that has a requirement or option of containing recycled content in accordance with Section 01 62 35 RECYCLED/RECOVERED MATERIALS, noting total price, total value of post-industrial recycled content, total value of post-consumer recycled content, exemptions (1, 2, 3, or 4, as indicated), and comments. Recycled content values may be determined by weight or volume percent, but must be consistent throughout.

1.7 WARRANTY MANAGEMENT

1.7.1 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 two sets of the warranty management plan. 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. 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. Furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

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

d. 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, including the starting date of 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.

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

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

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

1.7.2 Performance Bond

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

1.7.3 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 be 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.

1.7.4 Warranty Tags

At the time of installation, tag each warranted item with a durable, oil and water resistant tag approved by the Contracting Officer. Attach each tag with a copper wire and spray with a silicone waterproof coating. Also, submit two record copies of the warranty tags showing the layout and design. 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_____.

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

1.8 OPERATION AND MAINTENANCE MANUALS

Submit 2 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.

1.8.1 Configuration

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 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.

1.8.2 Training and Instruction

Submit classroom and field instructions in the operation and maintenance of systems equipment where required by the technical provisions. These services must be directed by the Contractor, using the manufacturer's factory-trained personnel or qualified representatives. 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.

1.9 WORK AREA CLEANUP

Provide final cleaning of contract work area in accordance with ASTM E 1971 and submit two copies of the listing of completed final clean-up items. Leave premises "broom clean." Comply with GS-37 for general purpose cleaning and bathroom cleaning. Use only nonhazardous cleaning materials, including natural cleaning materials, in the final cleanup. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. 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.

1.10 REAL PROPERTY TRANSFER DOCUMENTATION

Near the completion of Project, but not later than final transfer, complete and submit an accounting of all installed property with NASA Form NF1046 "Transfer and/or Notification of Acceptance of Accountability of Real Property."

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA
07/06

PART 1 GENERAL

1.1 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 preventive 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.

1.1.1 Package Quality

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

1.1.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Commissioned items without a specified data package requirement in the individual technical sections shall use Data Package 4. Commissioned items with a Data Package 1 or 2 requirement shall use instead Data Package 4.

1.1.3 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.

1.1.4 Review and Approval

The Contractor's Commissioning Authority (CA) shall review the commissioned systems and equipment submittals for completeness and applicability. The CA 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. The CA shall communicate deficiencies to the Contracting Officer. Upon a successful review of the corrections, the CA shall recommend approval and acceptance of these O&M

manuals to the Contracting Officer. This work shall be in addition to the normal review procedures for O&M data.

1.2 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.2.1 Operating Instructions

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

1.2.1.1 Safety Precautions

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

1.2.1.2 Operator Prestart

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

1.2.1.3 Startup, Shutdown, and Post-Shutdown Procedures

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

1.2.1.4 Normal Operations

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

1.2.1.5 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.

1.2.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.2.1.7 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.

1.2.2 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.

1.2.2.1 Lubrication Data

Include preventive 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.

1.2.2.2 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.

1.2.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs.

1.2.3.1 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.

1.2.3.2 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.

1.2.3.3 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.

1.2.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include

a combination of text and illustrations.

1.2.3.5 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.

1.2.4 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.

1.2.5 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:

1.2.5.1 Product Submittal Data

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

1.2.5.2 Manufacturer's Instructions

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

1.2.5.3 O&M Submittal Data

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

1.2.5.4 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

1.2.5.5 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.

1.2.5.6 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.

1.2.5.7 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.

1.2.5.8 Testing and Performance Data

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

1.2.5.9 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.

1.3 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 commissioning tests).

d. Full points list. A listing of rooms shall be provided with the following information for each room:

(1) Floor

(2) Room number

(3) Room name

(4) Air handler unit ID

(5) Reference drawing number

(6) Air terminal unit tag ID

(7) Heating and/or cooling valve tag ID

(8) Minimum cfm

(9) Maximum cfm

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

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

g. Electronic copy on disk or CD of the entire program for this facility.

h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

1.4 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:

1.4.1 Data Package 1

a. Safety precautions

b. Cleaning recommendations

c. Maintenance and repair procedures

d. Spare parts and supply list

e. Warranty information

f. Contractor information

1.4.2 Data Package 2

a. Safety precautions

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan and schedule

f. Cleaning recommendations

g. Maintenance and repair procedures

h. Removal and replacement instructions

i. Spare parts and supply list

j. Parts identification

k. Warranty information

l. Contractor information

1.4.3 Data Package 3

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Environmental conditions

g. Lubrication data

h. Preventive maintenance plan and schedule

i. Cleaning recommendations

j. Troubleshooting guides and diagnostic techniques

k. Wiring diagrams and control diagrams

l. Maintenance and repair procedures

m. Removal and replacement instructions

n. Spare parts and supply list

o. Product submittal data

p. O&M submittal data

q. Parts identification

r. Warranty information

s. Testing equipment and special tool information

t. Testing and performance data

u. Contractor information

1.4.4 Data Package 4

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Operator service requirements

g. Environmental conditions

h. Lubrication data

i. Preventive maintenance plan and schedule

j. Cleaning recommendations

k. Troubleshooting guides and diagnostic techniques

l. Wiring diagrams and control diagrams

m. Maintenance and repair procedures

n. Removal and replacement instructions

o. Spare parts and supply list

p. Corrective maintenance man-hours

q. Product submittal data

r. O&M submittal data

s. Parts identification

t. Warranty information

u. Personnel training requirements

v. Testing equipment and special tool information

w. Testing and performance data

x. Contractor information

1.4.5 Data Package 5

a. Safety precautions

b. Operator prestart

c. Start-up, shutdown, and post-shutdown procedures

d. Normal operations

e. Environmental conditions

f. Preventive maintenance plan and schedule

g. Troubleshooting guides and diagnostic techniques

h. Wiring and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Product submittal data

m. O&M submittal data

n. Parts identification

o. Warranty information

p. Testing equipment and special tool information

q. Testing and performance data

r. Contractor information

s. Manufacturer's instructions

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 86 26.07 40

RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS
02/12

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

This guide specification establishes acceptance requirements to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that will shorten the design life of the equipment. These requirements utilize Predictive Testing & Inspection (PT&I) technologies and are essential elements in the Government's Reliability Centered Building and Equipment Acceptance Program.

This guide specification is not intended to limit the inspection and acceptance process to the use of PT&I techniques. This guide is intended to supplement comprehensive and detailed commissioning and quality control specifications.

1.2 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.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

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

Quality Control Plan; G
Material, Equipment, and Fixture Lists; G

SD-02 Shop Drawings

Connection Diagrams; G
Fabrication Drawings; G
Installation Drawings; G

SD-03 Product Data

Manufacturer's Catalog Data; G
Equipment Foundation Data; G
Specific Equipment Data; G
Spare Parts List; G
Warranty; G

SD-06 Test Reports

Automatic Transfer Test; G
Battery Impedance Test; G
Continuity Test; G
Fall of Potential Test; G
General Battery Test; G
General Charger Test; G
Infrared Thermography Test; G
Point to Point Test; G
Visual Inspection; G

SD-07 Certificates

Certificates; G

SD-08 Manufacturer's Instructions

Manufacturer's Instructions; G

SD-10 Operation and Maintenance Data

Operations and Maintenance Manuals; G

SD-11 Closeout Submittals

Acceptance Documentation; G
Record Drawings; G
Baseline Data Report; G

1.4 QUALITY ASSURANCE

Submit a Quality Control plan outlining the intended methods of receiving, testing, and installing equipment. The RCBEA GUIDE specifies minimum test equipment requirements. Use trained and adequately certified personnel in the appropriate acceptance testing PT&I technologies to ensure that the results are accurate and consistent. Submit the following as part of the quality control plan for all required acceptance testing:

a. List of all test equipment used, including its manufacturer, model number, calibration date, certificate of calibration, and serial number.

b. Certificates of test personnel qualifications and certifications.

1.5 WARRANTY

Furnish workmanship and performance warranty for the work performed for a period not less than 1 years from the date of Government acceptance of the work; issued directly to the Government. Perform corrective action that becomes necessary because of defective materials and workmanship while system is under warranty 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the Contractor. Provide a 1 year minimum contractor installation warranty.

PART 2 PRODUCTS

2.1 PRODUCT DATA

Submit material, equipment, and fixture lists for all equipment, materials, and fixtures planned for use to complete the job before commencing work. Include at a minimum, the item's description, quantity, manufacturer's style or catalog numbers, and specification and drawing reference numbers. Provide a complete list of construction equipment to be used.

2.1.1 Manufacturer Product Data

Submit fabrication drawings for equipment and specialties consisting of fabrication and assembly details to be performed in the factory. Show connection diagrams and assemblies in switchgear fabrication drawings

Submit for all equipment listed. Include manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, equipment performance data charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit for each specified component.

Submit manufacturer's catalog data and equipment foundation data (as applicable) for the following equipment:

Include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

a. Batteries (Lead-Acid)

b. Battery Chargers

c. Breakers:

    (1) General

d. Cables:

    (1) General

    (2) Low Voltage (600V Maximum)

    (3) Medium Voltage (600V-33,000V)

e. Electrical Automatic Transfer Switches

f. Electrical Distribution Panels

g. Electrical Grounding Grid

h. Electrical Uninterruptible Power Supplies (UPS)

i. Electric Switches:

(1) Low Voltage Air, Safety Switches

(2) Medium Voltage Air, Metal Enclosed

j. Switchboards

k. Transformers

2.1.2 Certification Data

Submit applicable certificates for the equipment listed below showing conformance with test requirements, laboratory certifications, etc. as instructed by the project specification.

a. Batteries (General)

b. Batteries (Lead-Acid)

c. Battery Chargers

d. Breakers:

(1) General

e. Cables:

(1) General

(2) Low Voltage (600V Maximum)

(3) Medium Voltage (600V-33,000V)

f. Electrical Automatic Transfer Switches

g. Electrical Distribution Panels

h. Electrical Grounding Grid

i. Electrical UPS

j. Electric Switches:

(1) Low Voltage Air, Safety Switches

(2) Medium Voltage Air, Metal Enclosed

k. Switchboards

l. Transformers

2.1.3 Specific Equipment Data

Submit the following information for all equipment listed below: location of installation, AIR FORCE ARMY NASA NAVY Identification number, date of installation (required or actual acceptance date), and applicable AIR FORCE ARMY NASA NAVY reference drawing number. Unless explicitly stated in submitted manufacturer's literature, provide and submit the following specific equipment data:

a. Batteries (General)

(1) Battery identification (Type)

b. Battery (Lead-Acid)

(1) Battery identification (Type)

(2) Battery specifications

c. Battery Chargers

(1) Battery charger type

(2) Battery charger specifications

d. Breakers- General, Air Blast, Air Magnetic, Oil, SF6 Gas, and Vacuum Types

(1) Breaker type

(2) Breaker Specifications (including current transformer ratios)

e. Cables- Low, Medium, and High Voltage

(1) Power cable type

f. Electrical Automatic Transfer Switch (ATS)

(1) ATS Identification (Type)

g. Electrical Distribution Panel

(1) Electrical Control Panel Type (NEMA enclosure type)

(2) Voltage configuration (120/240 VAC, 12/24 VDC, etc.)

(3) Amperage (panel main bus maximum)

(4) Dimensions

(5) Weight

(6) UL certification

(7) Number of circuit breaker positions (outputs)

h. Electrical UPS

(1) Electrical rectifier type (enclosure type)

(2) Battery packageDC Voltage range

(3) Rectifier, static switchconfigurations

(4) Pulse number per unit, wave form type

(5) Dimensions, Weight

(6) UL certification

i. Electric Switch, All Types

(1) Switch type

(2) Switch specifications

j. Switchboard

(1) Switchboard type

(2) Switchboard specification data (voltage rating)

k. Transformers

(1) Transformer Type

(2) Winding resistance

(3) Transformer impedance

(4) Load loss at rated voltage and current

(5) Current loading

2.1.4 Extra Materials

Submit spare parts list data for each different item of material and equipment specified, after approval of detail drawings and not later than 3 months prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 12 months operation, and a list of the parts recommended by the manufacturer to be replaced after 1 year(s) of service.

PART 3 EXECUTION

3.1 INSTALLATION

Submit installation drawings for all installed equipment consisting of equipment layouts including assembly, applicable manufacturer's instructions, installation details and electrical connection diagrams; layout and installation details including support structures, conduit and related system components. Include on the drawings any information required to demonstrate that the system has been coordinated and will properly function within the electrical system, and show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

Submit connection diagrams for electrical equipment, panels, conduit, and specialties indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit record drawings, at least 14 days after completion of equipment installation and acceptance testing. Update electrical system drawings to

reflect final record as-built conditions after all related work is completed.

3.2 EXAMINATION

Perform visual inspection on the equipment listed below. Correct all abnormalities or defects as directed by the Contracting Officer.

a. Batteries (General)

b. Batteries (Lead-Acid)

c. Battery Chargers

d. Breakers:

(1) General

e. Cables:

(1) General

(2) Low voltage (600V Maximum)

(3) Medium voltage (600V-33,000V)

f. Electrical Automatic Transfer Switches

g. Electrical Distribution Panels

h. Electrical Grounding Grid

i. Electrical UPS

j. Electric Switches:

(1) Safety switches

k. Switchboard

l. Transformers

3.3 FIELD QUALITY CONTROL AND ACCEPTANCE TESTING

Deliver equipment and services that meet the contract requirements and specifications. Ensure all equipment is free of latent manufacturing and installation defects, and acceptance criteria are met. Perform acceptance testing as defined in this specification and the RCBEA GUIDE, using both traditional and PT&I technologies. The Government will observe and monitor the acceptance testing, analysis and documentation as part of the Government's Quality Assurance Program. Not until the requirements of acceptance are met will the equipment or facility be accepted by the Government.

3.3.1 Predictive Testing and Inspection Tests

Perform the following PT&I Tests in accordance with the requirements and criteria established in the RCBEA GUIDE. Include test point locations in all submitted reports.

Provide final test reports to the Contracting Officer. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words " Final Test Report Data - Forward to the Predictive Testing Group for inclusion in the Maintenance Information Database.

a. Perform Automatic Transfer Test for:

(1) Electrical Automatic Transfer Switch

b. Perform Battery Impedance Test for:

(1) Batteries (Lead-Acid)

c. Perform Contact Resistance Test for:

(1) Battery (Lead-Acid)

(2) Electrical Automatic Transfer Switch

(3) Electrical Distribution Panel

(4) Electric Switch, Medium Voltage Air, Metal Enclosed

d. Perform Fall of Potential Test for:

(1) Electrical Grounding Grid

e. Perform General Battery Test for:

(1) Battery (Lead-Acid)

f. Perform General Charger Test for:

(1) Battery Chargers

g. Perform Infrared Thermography Test for:

(1) Electrical Distribution Panel

(2) Switchboard

(3) Transformers

(4) Electrical Automatic Transfer Switch

(5) Electrical UPS

(6) Electric Switch, Medium Voltage Air, Metal Enclosed

h. Perform Insulation Oil Test for:

(1) Transformers

i. Perform Insulation Resistance Test for:

(1) Cables- Medium Voltage (600V-33,000V)

j. Perform Point to Point Test for:

(1) Electrical Grounding Grid

3.3.2 Baseline Data from Verification Testing

Upon completion of all PT&I tests submit baseline data report to the Contracting Officer. Include a summary of all performance data, set points, operating parameters and PT&I test results obtained for equipment and building systems.

3.4 OPERATIONS AND MAINTENANCE

Submit manufacturer's operations and maintenance manuals for the following equipment:

a. Batteries (General)

b. Batteries (Lead-Acid)

c. Battery Chargers

d. Breakers:

(1) General

e. Cables:

(1) General

(2) Low Voltage (600V Maximum)

(3) Medium Voltage (600V-33,000V)

f. Electrical Automatic Transfer Switches

g. Electrical Distribution Panels

h. Electrical UPS

i. Electric Switches:

(1) Safety Switchesr

(2) Medium Voltage Air, Metal Enclosed

j. Switchboard

k. Transformers

Submit six complete copies of operations and maintenance manuals in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown. Include the manufacturer's name, model number, parts list, routine maintenance procedures, possible breakdowns and repairs, trouble shooting guide, and a brief description of all equipment and their basic operating features. Include piping and equipment layouts and simplified wiring and control diagrams of the system as installed. Where available, provide technical manuals in electronic format with Standard Graphics Markup Language. When electronic format publications are provided, only two

copies of the document are required. Submit operations and maintenance manuals 30 calendar days prior to testing any equipment.

3.5 ACCEPTANCE DOCUMENTATION

Upon completion of the project and acceptance testing the Contracting Officer will provide acceptance documentation to the Contractor. Complete, sign and date this documentation and submit back to the Contracting Officer for processing and approval.

-- End of Section --

SECTION 02 41 00

DEMOLITION
05/10

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 A10.6	(1990; R 1998) Safety Requirements for Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2003) Safety -- Safety and Health Requirements

U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25	(2000) Storage and Handling of Liquefied and Gaseous Compressed Gases and Their Full and Empty Cylinders

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M	(2000) Requisitioning and Issue Procedures
MIL-STD-129	(Rev P) Military Marking for Shipment and Storage

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

40 CFR 61-SUBPART M	National Emission Standard for Asbestos
49 CFR 173.301	Shipment of Compressed Gases in Cylinders and Spherical Pressure Vessels

1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the Contracting Officer. Remove rubbish and debris from the station daily; do not allow accumulations inside or outside the buildings or on airfield pavements. The work includes demolition and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Contro approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Notifications: G

Demolition plan; G

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

SD-11 Closeout Submittals

Receipts

Receipts or bills of lading, as specified.

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 ANSI A10.6.

1.4.1 Notifications

1.4.1.1 General Requirements

Furnish timely notification of demolition and renovation projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61-SUBPART M. Notify the Regional Office of the United States Environmental Protection Agency (USEPA), State's environmental protection agency, local air pollution control district/agency, and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61-SUBPART M.

1.4.2 Receipts

Submit a shipping receipt or bill of lading for all containers of ozone depleting substance (ODS) shipped to the Defense Depot, Richmond, Virginia.

1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris to occupied portions of the building, on airfield pavements, 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, flooding or pollution. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to aircraft.

1.6 PROTECTION

1.6.1 Traffic Control Signs

Where pedestrian and driver or aircraft 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, jet or prop blast. Notify the Contracting Officer prior to beginning such work.

1.6.2 Existing Conditions Documentation

Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing work in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, the location and extent of cracks and other damage, and description of surface conditions that exist prior to starting work.

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, or demolition work performed under this contract. Do not overload structural elements or pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement require approval by the 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, 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 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, 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, or demolition work performed under this contract.

1.6.9 Protection of Personnel

Before, during and after the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition 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 FOREIGN OBJECT DAMAGE (FOD)

Aircraft and aircraft engines are subject to FOD from debris and waste material lying on airfield pavements. Remove all such materials that may appear on operational aircraft pavements due to the Contractor's operations. If necessary, the Contracting Officer may require the Contractor to install a temporary barricade at the Contractor's expense to control the spread of FOD potential debris. The barricade must include a fence covered with a fabric designed to stop the spread of debris. Anchor the fence and fabric to prevent displacement by winds or jet/prop blasts. Remove barricade when no longer required.

1.9 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.

1.10 REQUIRED DATA

The Demolition plan shall include procedures for: careful removal and disposition of materials specified to be salvaged; coordination with other work in progress; a disconnection schedule of utility services; and, airfield lighting; a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work. Provide procedures for safe conduct of the work in accordance with EM 385-1-1.

1.11 ENVIRONMENTAL PROTECTION

Comply with the Environmental Protection Agency requirements specified.

1.12 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 of structures.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Utilities and Related Equipment

3.1.1.1 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 work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.1.2 Disconnecting Existing Utilities

Remove existing utilities, as indicated and/or 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 on the station in accordance with instructions of the Contracting Officer.

3.1.2 Chain Link Fencing

Remove chain link fencing, gates and other related salvaged items scheduled for removal and transport to designated areas. Remove gates as whole

units. Cut chain link fabric to 25 foot lengths and store in rolls off the ground.

3.1.3 Paving and Slabs

Remove by sawcutting concrete and asphaltic concrete paving and slabs including aggregate base, as indicated. Provide neat sawcuts at limits of pavement removal as indicated.

3.1.4 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition work in areas occupied by structures to be demolished until all demolition in the area has been completed and debris removed. Holes, open basements and other hazardous openings shall be filled.

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 materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition and removal procedures, and authorization by the Contracting Officer to begin demolition. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

3.3.2 Transportation Guidance

Shipment of all ODS containers shall be in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

3.3.3 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of off Government property.

3.4 CLEANUP

Debris and rubbish shall be removed and transported 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 Disposal

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations in accordance with all applicable federal, state and local regulations as contractually specified off the center. Removed materials shall not be stored on the project site.

3.5.2 Burning on Government Property

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

3.5.3 Removal from Government Property

Transport waste materials removed from demolished structures, except waste soil, from Government property for legal disposal. Dispose of waste soil off of Government property, as indicated or as directed by the Contracting Officer.

-- End of Section --

SECTION 05 50 13

MISCELLANEOUS METALAND FABRICATIONS
05/10

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 A10.3	(1995) Operations -- Safety Requirements for Powder Actuated Fastening Systems
ANSI B18.2.1	(1996; Errata 2003) Square and Hex Bolts and Screws Inch Series
ANSI B18.6.2	(1972; R 1993) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws
ANSI B18.6.3	(1998) Machine Screws and Machine Screw Nuts

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2006) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.2	(1987; R 2005) Square and Hex Nuts
ASME B18.21.1	(1999; R 2005) Lock Washers (Inch Series)
ASME B18.22.1	(1965; R 2003) Plain Washers

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2005) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A193/A193M	(2012a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A 307	(2004) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 36/A 36M	(2005) Carbon Structural Steel

ASTM A 467/A 467M	(2001) Machine and Coil Chain
ASTM A 47/A 47M	(2004) Ferritic Malleable Iron Castings
ASTM A 500	(2003a) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 53	(2004) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 653/A 653M	(2004a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 687	(1993) High-Strength Nonheaded Steel Bolts and Studs
ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 924/A 924M	(2004) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C 881/C 881M	(2010) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM D 1187	(1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E 488	(1996; R 2003) Strength of Anchors in Concrete and Masonry Elements

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(Jan 2004) Alkyd Anti-Corrosive Metal Primer

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6	(2000; R 2004) 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. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Guard posts (bollards/pipe guards); G

Embedded angles and plates, installation drawings; G

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 Structural Tubing

ASTM A 500.

2.1.3 Steel Pipe

ASTM A 53, Type E or S, Grade B.

2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A 47/A 47M.

2.1.5 Anchor Bolts

ASTM A 307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.5.1 Expansion Anchors

Provide expansion anchors, size and embedment as indicated. Design values listed shall be as tested according to ASTM E 488. Exoansion anchors shall be Type 316 stainless steel conforming to ASTM A193/A193Mfor corrosion resistance. Expansion anchors shall be drilled into supporting slabs and anchored with epoxy conforming to ASTM C 881/C 881M

a. Minimum allowable pullout value shall be as indicated.

b. Minimum allowable shear value shall be as indicated.

2.1.5.2 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 and ASTM A 687 or ASTM A 307.

2.1.5.3 Powder Driven Fasteners

Follow safety provisions of ANSI A10.3.

2.1.5.4 Screws

ANSI B18.2.1, ANSI B18.6.2, and ANSI B18.6.3.

2.1.5.5 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.

2.1.5.6 Safety Chains

Provide 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 3.5 feet above ground and mount the lower chain 1.5 feet above the ground.

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 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 metallic's 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. 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.

2.3 GUARD POSTS (BOLLARDS/PIPE GUARDS)

Provide prime coated standard weight steel pipe diameter as indicated and as specified in ASTM A 53. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 3000 psi. securely attach safety chains between anchor points permanently attach to guard posts as indicated.

2.4 MISCELLANEOUS PLATES AND SHAPES

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.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

3.2 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be 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 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.5 FINISHES

3.5.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with 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.

3.5.2 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.

3.5.3 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.

3.6 INSTALLATION OF GUARD POSTS (BOLLARDS/PIPE GUARDS)

Pipe guards shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with concrete having a minimum compressive strength of 3000 psi.

-- End of Section --

SECTION 07 84 00

FIRESTOPPING
10/07

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 119	(2009c) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 1399	(1997; R 2005) Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E 1966	(2007) Fire-Resistive Joint Systems
ASTM E 814	(2009) Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ASTM E 84	(2009c) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM AS 4991	(2001) Approval of Firestop Contractors
FM P7825a	(2005) Approval Guide Fire Protection

UNDERWRITERS LABORATORIES (UL)

UL 1479	(2003; Rev thru Dec 2008) Standard for Fire Tests of Through-Penetration Fire Stops
UL 2079	(2004; Mar 2006) Tests for Fire Resistance of Building Joint Systems
UL 723	(2008) Standard for Test for Surface Burning Characteristics of Building Materials
UL Fire Resistance	(2009) Fire Resistance Directory

1.2 SYSTEM DESCRIPTION

Furnish and install tested and listed firestopping systems, combination of materials, or devices to form an effective barrier against the spread of

flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint. Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above.

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

Firestopping Materials.

Detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgement, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal shall indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" and "T" ratings, and type of application.

SD-07 Certificates

Firestopping Materials.

Certificates attesting that firestopping material complies with the specified requirements. In lieu of certificates, drawings showing UL classified materials as part of a tested assembly may be provided. Drawings showing evidence of testing by an alternate nationally recognized independent laboratory may be substituted.

Installer Qualifications.

Documentation of training and experience.

1.4 1.4 QUALITY ASSURANCE

Engage an experienced Installer who is:

a. FM Research approved in accordance with FM AS 4991, or

b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products in

accordance with specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer installer qualifications on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name. Store materials off the ground, protected from damage and exposure to elements. Remove damaged or deteriorated materials from the site.

1.6 SEQUENCING

Coordinate the specified work with other trades. Apply firestopping materials, at penetrations of pipes and ducts, prior to insulating, unless insulation meets requirements specified for firestopping. Apply firestopping materials at building joints and construction gaps, prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Provide firestopping materials consisting of commercially manufactured, asbestos-free, noncombustible products FM P7825a approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resistance or by a nationally recognized testing laboratory.

2.1.2 Toxicity

Material shall be nontoxic to humans at all stages of application or during fire conditions.

2.1.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resistance listed or FM P7825a approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected, except that "F" rating may be 3 hours in through-penetrations of 4 hour fire rated wall or floor. Firestop systems shall also have "T" rating where required.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph SYSTEM DESCRIPTION, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479. Fire resistance ratings shall be as

follows:

a. Penetrations of Fire Resistance Rated Walls and Partitions: F Rating = Rating of wall or partition being penetrated.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph SYSTEM DESCRIPTION, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E 119, ASTM E 1966 or UL 2079 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement shall be sound and capable of supporting device. Prepare surfaces as recommended by the manufacturer.

3.2 INSTALLATION

Completely fill void spaces with firestopping material regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 4 inches or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems in the following locations, except in floor slabs on grade:

a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.

b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.

c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.

d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

e. Construction joints in floors and fire rated walls and partitions.

f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Replace thermal insulation with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping products that do not cure over time. Firestopping shall be modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves, adds or changes without the need to remove or replace any firestop materials.

-- End of Section --

SECTION 13 34 19

METAL BUILDING SYSTEMS
11/11

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 ADM-105	(2005; Errata 2005) Aluminum Design Manual
AA ASD1	(2009) Aluminum Standards and Data

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2011) Steel Construction Manual
AISC 341	(2010) Seismic Provisions for Structural Steel Buildings
AISC 360	(2010) Specification for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121	(2004) Standard Definitions for Use in the Design of Steel Structures
AISI SG03-3	(2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010; Change 2010; Change 2011; Errata 2011; Change 2011) Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2012; Errata 2011) Structural Welding Code - Steel
AWS D1.3/D1.3M	(2008; Errata 2008) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	(2012) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural,

	High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A1011/A1011M	(2012) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability and Ultra-High Strength
ASTM A123/A123M	(2012) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A193/A193M	(2012a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A307	(2010) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A325	(2010) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A463/A463M	(2010) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A475	(2003a; E 2009; R 2009) Standard Specification for Zinc-Coated Steel Wire Strand
ASTM A500/A500M	(2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A501	(2007) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A529/A529M	(2005; R 2009) Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	(2007) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A572/A572M	(2012) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A606/A606M	(2009a) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A755/A755M	(2011) Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A792/A792M	(2010) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM A992/A992M	(2011) Standard Specification for Structural Steel Shapes
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B209	(2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2012) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	(2012) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B695	(2004; R 2009) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C1289	(2012) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

ASTM C1363	(2011) Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
ASTM C273/C273M	(2011) Shear Properties of Sandwich Core Materials
ASTM C518	(2010) Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C553	(2011) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C612	(2010) Mineral Fiber Block and Board Thermal Insulation
ASTM C665	(2012) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM C991	(2008; E 2008) Flexible Glass Fiber Insulation for Metal Buildings
ASTM D1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1308	(2002; R 2007) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D1621	(2010) Compressive Properties of Rigid Cellular Plastics
ASTM D1622	(2008) Apparent Density of Rigid Cellular Plastics
ASTM D1667	(2005; R 2011) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D2244	(2011) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2247	(2011) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D2794	(1993; R 2010) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3363	(2005; E 2011; R 2011; E 2012) Film Hardness by Pencil Test

ASTM D4214	(2007) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D522	(1993a; R 2008) Mandrel Bend Test of Attached Organic Coatings
ASTM D523	(2008) Standard Test Method for Specular Gloss
ASTM D6226	(2010) Standard Test Method for Open Cell Content of Rigid Cellular Plastics
ASTM D714	(2002; R 2009) Evaluating Degree of Blistering of Paints
ASTM D822	(2001; R 2006) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D968	(2005; R 2010) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM DEFONLINE	(2008) ASTM Online Dictionary of Engineering Science and Technology
ASTM E119	(2012a) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E136	(2012) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E1592	(2005; R 2012) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E1646	(1995; R 2011) Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Air Pressure Difference
ASTM E168	(2006) General Techniques of Infrared Quantitative Analysis
ASTM E283	(2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	(2000; R 2009) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E84	(2012b) Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM F1554	(2007a; E 2011) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F1852	(2011) Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM F436	(2011) Hardened Steel Washers
ASTM F844	(2007a) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM G152	(2006) Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	(2004; R 2010) Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA MBSM	(2002) Metal Building Systems Manual

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252	(2012) Standard Methods of Fire Tests of Door Assemblies
NFPA 80	(2013) Standard for Fire Doors and Other Opening Protectives

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA RoofMan	(2012) The NRCA Roofing Manual

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 15	(1999; E 2004) Steel Joist Shop Primer
SSPC Painting Manual	(2002) Good Painting Practice, Steel Structures Painting Manual, Volume 1
SSPC SP 2	(1982; E 2000; E 2004) Hand Tool Cleaning

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (2012) Building Materials Directory

1.2 GENERAL REQUIREMENTS

1.2.1 Structural Performance

Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within the limits and conditions indicated.

1.2.1.1 Engineering

Design metal building systems conforming to procedures described in MBMA MBSM.

1.2.1.2 Design Loads

Conform to the requirements of MBMA MBSM, ASCE 7, and the building code applicable to the project geographical location.

1.2.1.3 Live Loads

Include all vertical loads induced by the building occupancy indicated on the drawings, as well as loads induced by maintenance workers, materials and equipment for roof live loads.

1.2.1.4 Wind Loads

Include horizontal loads induced by a basic wind speed Project site of 120.

1.2.1.5 Collateral Loads

Include additional dead loads other than the weight of metal building system for permanent items such as sprinklers, mechanical systems, electrical systems, and ceilings.

1.2.1.6 Auxiliary Loads

Include dynamic live loads, such as those generated by cranes and materials-handling equipment indicated on detail drawings.

1.2.1.7 Load Combinations

Design metal building systems to withstand the most critical effects of load factors and load combinations as required by MBMA MBSM, ASCE 7, and the building code applicable to the project location.

1.2.1.8 Deflection Limits

Engineer assemblies to withstand design loads with deflections no greater than the following:

a. Purlins and Rafters; vertical deflection of 1/180 of the span.

b. Girts; horizontal deflection of 1/180 of the span.

c. Metal Roof Panels; vertical deflection of 1/180 of the span.

d. Metal Wall Panels; horizontal deflection of 1/180 of the span.

Design secondary framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings. Provide metal panel assemblies capable of withstanding the effects of loads and stresses indicated, based on testing according to ASTM E1592.

1.2.2 Seismic Performance

Design and engineer metal building system capable of withstanding the effects of earthquake motions determined according to ASCE 7, AISC 341, and the applicable portions of the building code in the geographic area where the construction will take place.

1.2.3 Thermal Movements

Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss as follows:

Temperature Change (Range); 120 F, ambient; 180 F, material surfaces.

1.2.4 Thermal Performance

Provide insulated metal panel assemblies with the following maximum U-factors and minimum R-values for opaque elements when tested according to ASTM C1363 or ASTM C518.

1.2.4.1 Metal Roof Panel Assemblies

a. R-Value: R38

1.2.4.2 Metal Wall Panel Assemblies

a. R-Value: R19

1.2.5 Air Infiltration for Metal Roof Panels

Air leakage through assembly must not exceed 0.06 cfm/sq.ft. of roof area when tested according to ASTM E168 at negative test-pressure difference of 1.57 lb/sq.ft.

1.2.6 Air Infiltration for Metal Wall Panels

Air leakage through assembly of not more than 0.06 cfm/sq.ft. of wall area when tested according to ASTM E283 at static-air-pressure difference of 6.24 lbf/sq.ft.

1.2.7 Water Penetration for Metal Roof Panels

No water penetration when tested according to ASTM E1646 at test-pressure difference of 2.86 lbf/sq.ft.

1.2.8 Water Penetration for Metal Wall Panels

No water penetration when tested according to ASTM E331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq.ft. and not more than 12 lbf/sq. ft.

1.2.9 Wind-Uplift Resistance

Provide metal roof panel assemblies that comply with ASCE 7.

1.3 DEFINITIONS

ASTM DEFONLINE applies to this definition paragraph.

a. Bay: Dimension between main frames measured normal to frame (at centerline of frame) for interior bays, and dimension from centerline of first interior main frame measured normal to end wall (outside face of end-wall girt) for end bays.

b. Building Length: Dimension of the building measured perpendicular to main framing from end wall to end wall (outside face of girt to outside face of girt).

c. Building Width: Dimension of the building measured parallel to main framing from sidewall to sidewall (outside face of girt to outside face of girt).

d. Clear Span: Distance between supports of beams, girders, or trusses (measured from lowest level of connecting area of a column and a rafter frame or knee).

e. Eave Height: Vertical dimension from finished floor to eave (the line along the sidewall formed by intersection of the planes of the roof and wall).

f. Clear Height under Structure: Vertical dimension from finished floor to lowest point of any part of primary or secondary structure, not including crane supports, located within clear span.

g. Terminology Standard: Refer to MBMA "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.

1.4 SYSTEM DESCRIPTION

General: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior. Include primary and secondary framing, metal roof panels, metal wall panels, and accessories complying with requirements indicated.

Provide metal building system of size and with spacing, slopes, and spans indicated.

1.4.1 Primary Frame Type

a. Rigid Clear Span: Solid-member, structural-framing system without interior columns.

1.4.2 Fixed End-Wall Framing

Provide manufacturer's standard fixed end wall, for buildings not required to be expandable, consisting of load-bearing end-wall with corner columns, and rafters.

1.4.3 Expandable End-Wall Framing

Provide engineered end walls to be expandable. Provide primary frame, capable of supporting full-bay design loads, and end-wall columns.

1.4.4 Secondary Frame Type

Provide manufacturer's standard purlins and joists and flush-framed girts.

1.4.5 Eave Height

Eave height must be Manufacturer's standard height, as indicated by nominal height on Drawings.

1.4.6 Bay Spacing

Bay Spacing must be As determined by manufacturer.

1.4.7 Roof Slope

Roof slope must be 1 inch per 12 inches or manufacturer's standard for frame type required.

1.4.8 Roof System

Provide manufacturer's standard metal roof panels with insulation.

1.4.9 Exterior Wall System

Provide manufacturer's standard field-assembled, insulated or factory-assembled, insulated metal wall panels.

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

Manufacturer's Qualifications; G

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Manufacturer's data indicating percentage of recycle material of the following to verify sustainable acquisition compliance; G

Manufacturer's catalog data; G

SD-04 Samples

Metal Closure Strips 10 inches long of each type; G
Insulation, approximately 8 by 11 inches; G
Vapor Barrier; G
Manufacturer's color charts and chips, 4 by 4 inches; G

SD-05 Design Data

Manufacturer's descriptive and technical literature; G
Manufacturer's building design analysis; G

SD-06 Test Reports

Test reports; G
Coatings and base metals ; G
Factory Color Finish Performance Requirements; G

SD-07 Certificates

system components; G
Coil Stock certification; G
Aluminized Steel Repair Paint; G
Galvanizing Repair Paint; G
Enamel Repair Paint; G
Qualification of Manufacturer; G
Qualification of Erector; G

SD-08 Manufacturer's Instructions

Installation of Roof and Wall panels; G
shipping, handling, and storage; G

SD-11 Closeout Submittals

Manufacturer's Warranty; G
Contractor's Warranty for Installation; G

1.6 QUALITY ASSURANCE

1.6.1 Pre-Erection Conference

After submittals are received and approved but before metal building system work, including associated work, is performed, the Contracting Officer will hold a pre-erection conference to review the following:

a. The detail drawings, specifications, and manufacturer's descriptive and technical literature.

b. Finalize construction schedule and verify availability of materials, erector's personnel, equipment, and facilities needed to make progress and avoid delays.

c. Methods and procedures related to metal building system erection, including, but not limited to: qualification of manufacturer, qualification of erector, manufacturer's catalog data, building design analysis, written instructions and test reports.

d. Support conditions for compliance with requirements, including alignment between and erection of structural members.

e. Flashing, special roofing and siding details, roof and wall penetrations, openings, and condition of other construction that will affect metal building system, including coatings and base metals, factory color finish performance requirements, system components, and certificates for coil stock.

f. Governing regulations and requirements for, certificates, insurance, tests and inspections if applicable.

g. Temporary protection requirements for metal panel assembly during and after installation.

h. Samples of aluminized steel repair paint, galvanizing repair paint, and enamel repair paint.

1.6.2 Manufacturer's Technical Representative

The representative must have authorization from manufacturer to approve field changes and be thoroughly familiar with the products, erection of structural framing and installation of roof and wall panels in the geographical area where construction will take place.

1.6.3 Manufacturer's Qualifications

Metal building system manufacturer must have a minimum of five (5) years experience as a qualified manufacturer of metal building systems and accessory products.

Provide engineering services by an authorized currently licensed engineer in the geographical area where construction will take place, having a minimum of four years experience as an engineer knowledgeable in building design analysis, protocols and procedures for the "Metal Building Systems Manual" (MBMA MBSM); ASCE 7, and ASTM E1592.

Provide certified engineering calculations using the products submitted for:

a. Roof and Wall Wind Loads with basic wind speed, exposure category, co-efficient, importance factor, designate type of facility, negative pressures for each zone, methods and requirements of attachment.

b. Roof Dead and Live Loads

c. Collateral Loads

d. Foundation Loads

e. Seismic Loads

1.6.4 Qualification of Erection Contractor

An experienced erector who has specialized in erecting and installing work

similar in material, design, and extent to that indicated for this Project and must be approved and certified by the metal building system manufacturer.

1.6.5 Single Source

Obtain primary and secondary components and structural framing members, each type of metal roof, wall and liner panel assemblies, clips, closures and other accessories from the standard products of the single source from a single manufacturer to operate as a complete system for the intended use.

1.6.6 Welding

Qualify procedures and personnel according to AWS A5.1/A5.1M, AWS D1.1/D1.1M, and AWS D1.3/D1.3M.

1.6.7 Structural Steel

Comply with AISC 325, AISC 341 for seismic impacted designs, AISC 360, for design requirements and allowable stresses.

1.6.8 Cold-Formed Steel

Comply with AISC/AISI 121 and AISI SG03-3 for design requirements and allowable stresses.

1.6.9 Fire-Resistance Ratings

Where indicated, provide metal panels identical to those of assemblies tested for fire resistance per ASTM E119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

Indicate design designations from UL Bld Mat Dir or from the listings of another qualified testing agency. Combustion Characteristics must conform to ASTM E136.

1.6.10 Surface-Burning Characteristics

Provide metal panels having insulation core insulation and vapor barrier material with the following surface-burning characteristics as determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency showing:

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

1.6.11 Fabrication

Fabricate and finish metal panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles with dimensional and structural requirements

Provide metal panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel. Aluminum and aluminum-alloy sheet and plate must conform to ASTM B209.

Fabricate metal panel side laps with factory-installed captive gaskets or

separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within panel assembly.

Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated:

a. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

b. End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

c. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

e. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA or by metal building system manufacturer for application, but not less than thickness of metal being secured.

1.6.12 Finishes

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

1.7 SHIPPING, HANDLING AND STORAGE

1.7.1 Delivery

Package and deliver components, sheets, metal panels, and other manufactured items so as not to be damaged or deformed and protected during transportation and handling.

Stack and store metal panels horizontally on platforms or pallets, covered with suitable weather-tight and ventilated covering to ensure dryness, with positive slope for drainage of water. Store in a manner to prevent bending, warping, twisting, and surface damage. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage. Retain strippable protective covering on metal panel for entire period up to metal panel installation.

Protect foam-plastic insulation as follows:

a. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

b. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to project site before installation time.

Complete installation and concealment of plastic materials as rapidly as possible in each area of construction to minimize ultraviolet exposure.

1.8 PROJECT CONDITIONS

1.8.1 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into existing panel system or building.

1.8.2 Field Measurements

1.8.2.1 Established Dimensions for Foundations

Comply with established dimensions on approved anchor-bolt plans, established foundation dimensions, and proceed with fabricating structural framing. Do not proceed without verifying field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.

1.8.2.2 Established Dimensions for Metal Panels

Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.8.2.3 Verification Record

Verify locations of all framing and opening dimensions by field measurements before metal panel fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION

Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Section 32 13 00 CAST-IN-PLACE CONCRETE.

Coordinate installation of equipment supports , which are specified in Division 22 - PLUMBING.

Coordinate installation of HVAC system equipment supports ductwork and supports piping and supports and accessories, which are specified in Division 23 - HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).

Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leak-proof, secure, and non-corrosive installation.

1.10 WARRANTY

1.10.1 Building System Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal building

system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government. The warranty must provide that if within the warranty period, the metal building system shows evidence of deterioration resulting from defective materials and/or workmanship, correcting of any defects is the responsibility of the metal building system manufacturer. Repairs that become necessary because of defective materials and workmanship while metal building system is under warranty are to be performed within 32 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 32 hours of notification will constitute grounds for having emergency repairs performed by others and will not void the warranty.

1.10.2 Roof System Weather-Tightness Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal panel system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government.

The warranty is to provide that if within the warranty period the roof panel system shows evidence of corrosion, perforation, rupture, lost of weather-tightness or excess weathering due to deterioration of the panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal building system manufacturer.

Repairs that become necessary because of defective materials and workmanship while roof panel system is under warranty are to be performed within 24 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform temporary repairs within 24 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty. Immediate follow-up and completion of permanent repairs must be performed within 7 days from date of notification.

1.10.3 Roof and Wall Panel Finish Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal panel system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government.

The warranty is to provide that if within the warranty period the metal panel system shows evidence of checking, delaminating cracking, peeling, chalk in excess of a numerical rating of eight, as determined by ASTM D4214 test procedures; or change colors in excess of five CIE or Hunter units in accordance with ASTM D2244 or excess weathering due to deterioration of the panel system resulting from defective materials and finish or correction of the defective workmanship is to be the responsibility of the metal building system manufacturer.

Liability under this warranty is exclusively limited to replacing the defective coated materials.

Repairs that become necessary because of defective materials and workmanship while roof and wall panel system is under warranty are to be performed within 32 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 32 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty.

PART 2 PRODUCTS

2.1 STRUCTURAL FRAMING MATERIALS

2.1.1 W-Shapes

ASTM A992/A992M; ASTM A572/A572M or ASTM A529/A529M.

2.1.2 Channel, Angles, M-Shapes and S-Shapes

ASTM A36/A36M; ASTM A572/A572M or ASTM A529/A529M.

2.1.3 Plate and Bar

ASTM A36/A36M, ASTM A572/A572M or ASTM A529/A529M.

2.1.4 Steel Pipe

ASTM A36/A36M, ASTM A53/A53M, ASTM A572/A572M or ASTM A529/A529M.

2.1.5 Cold-Formed and Hot Formed Hollow Structural Sections

Cold formed:ASTM A500/A500M or ASTM B221, ASTM B221M. Hot-formed: ASTM A501.

2.1.6 Structural-Steel Sheet

Hot-rolled, ASTM A1011/A1011M or cold-rolled, ASTM A1008/A1008M.

2.1.7 Metallic-Coated Steel Sheet

ASTM A653/A653M, ASTM A606/A606M.

2.1.8 Metallic-Coated Steel Sheet Pre-painted with Coil Stock Coating

Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A755/A755M.

a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, and ASTM A123/A123M.

b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, and ASTM A463/A463M.

2.1.9 High-Strength Bolts, Nuts, and Washers

ASTM A325, heavy hex steel structural bolts; ASTM A563 heavy hex carbon-steel nuts; and ASTM F436 hardened carbon-steel washers.

Finish: Hot-dip zinc coating, ASTM A153/A153M Mechanically deposited zinc coating, ASTM B695.

Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F1852, heavy-hex-head steel structural bolts with spline.

Finish: Mechanically deposited zinc coating, ASTM B695 Mechanically deposited zinc coating, ASTM B695 baked epoxy coated.

2.1.10 Non-High-Strength Bolts, Nuts, and Washers

ASTM A307, ASTM A563, and ASTM F844.

Finish: ASTM A153/A153M ASTM B695.

2.1.11 Anchor Rods

ASTM F1554 ASTM A572/A572M ASTM A36/A36M ASTM A307.

a. Configuration: Straight.
b. Nuts: ASTM A563 hex carbon steel.
c. Plate Washers: ASTM A36/A36M carbon steel.
d. Washers: ASTM F436 hardened carbon steel.
e. Finish: Hot-dip zinc coating, ASTM A153/A153MMechanically deposited zinc coating, ASTM B695.

2.1.12 Threaded Rods

ASTM A193/A193M ASTM A572/A572M ASTM A36/A36M ASTM A307.

a. Nuts: ASTM A563 hex carbon steel.
b. Washers: ASTM F436 hardened ASTM A36/A36M carbon steel.
c. Finish: Hot-dip zinc coating, ASTM A153/A153M Mechanically deposited zinc coating, ASTM B695.

2.1.13 Primer

SSPC-Paint 15, Type I, red oxide.

2.2 FABRICATION

2.2.1 General

Comply with MBMA MBSM - "Metal Building Systems Manual": Chapter IV, Section 9, "Fabrication and Erection Tolerances."

2.3 STRUCTURAL FRAMING

2.3.1 General

Clean all framing members to remove loose rust and mill scale. Provide 1 shop coat of primer to an average dry film thickness of 1 mil according to SSPC SP 2. Balance of painting and coating procedures must conform to SSPC Paint 15 and SSPC Painting Manual.

2.3.2 Primary Framing

Manufacturer's standard structural primary framing system includes transverse and lean-to frames; rafter, rakes, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing designed to withstand required loads and specified requirements. Provide frames with attachment plates, bearing plates, and splice members. Provide frame span and spacing indicated.

Shop fabricate framing components by welding or by using high-strength bolts to the indicated size and section with base-plates, bearing plates, stiffeners, and other items required. Cut, form, punch, drill, and weld framing for bolted field erection.

a. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.

b. Rigid Modular Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from steel round pipe steel tube shop-welded, built-up steel plates.

c. Frame Configuration: Single gable.

d. Exterior Column Type: Uniform depth.

e. Rafter Type: Uniform depth.

2.3.3 Secondary Framing

Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet pre-painted with coil coating, unless otherwise indicated.

Shop fabricate framing components by roll-forming or break-forming to the indicated size and section with base-plates, bearing plates, stiffeners, and other plates required for erection. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

a. Purlins: C or Z-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes; minimum depth As required to comply with system performance requirements.

b. Girts: C or Z-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees to flange minimum depth as required to comply with system performance requirements.

c. Eave Struts: Unequal-flange, C-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes; to provide adequate backup for metal panels.

d. Flange Bracing: Structural-steel angles or cold-formed structural tubing to stiffen primary frame flanges.

e. Sag Bracing: Structural-steel angles.

f. Base or Sill Angles: Zinc-coated (galvanized) steel sheet.

g. Purlin and Girt Clips: Steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.

h. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from zinc-coated (galvanized) steel sheet.

i. Framing for Openings: Channel shapes; fabricated cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings, and head, jamb, and sill of other openings.

j. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

2.3.4 Bracing

Provide adjustable wind bracing as follows:

a. Rods: ASTM A36/A36M; ASTM A572/A572M; or ASTM A529/A529M threaded full length at each end.

b. Cable: ASTM A475, 3/8" diameter, extra-high-strength grade, zinc-coated, 7-strand steel; with threaded end anchors.

c. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.

d. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

e. Fixed-Base Columns: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

f. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.

g. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.

2.4 PANEL MATERIALS

2.4.1 Aluminum Sheet

Roll-form aluminum panels to the specified profile, with fy = .050 inch thickness and depth as indicated. Material must be plumb and true, and within the tolerances listed:

a. Aluminum Sheet conforming to ASTM B209, AA ADM-105 and AA ASD1.

b. Individual panels to have continuous length to cover the entire length of any roof slope wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

c. Provide panels with thermal expansion and contraction consistent with the type of system specified.

1. Profile and coverage to be a minimum height and width from manufacturer's standard for the indicated roof slope wall area.

2. Profile to be a 1-1/2 inch high rib at 12 inches o.c. with small stiffening ribs, 38 inch overall width with 36 inch coverage and exposed fasteners.

3. Profile to be a 1 inch high standing seam, 12 inch coverage, with

mechanical crimping or snap-together seams with concealed clips and fasteners.

4. Smooth, flat Surface Texture.

2.4.2 Steel Sheet

Roll-form steel panels to the specified profile, with fy = 22 gauge and depth as indicated. Material must be plumb and true, and within the tolerances listed:

a. Galvanized Steel Sheet conforming to ASTM A653/A653M and AISI SG03-3.

b. Aluminum-Zinc Alloy-coated Steel Sheet conforming to ASTM A792/A792M and AISI SG03-3.

c. Individual panels to have continuous length to cover the entire length of any unbroken roof slope wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

d. Provide panels with thermal expansion and contraction consistent with the type of system specified;

Profile and coverage to be a minimum height and width from manufacturer's standard for the indicated roof slope wall area.

Profile to be a 1-1/2 inch high rib at 12 inches o.c. with small stiffening ribs, 38 inch overall width with 36 inch coverage and exposed fasteners.

Profile to be a 1 inch high standing seam, 12 inch coverage, with mechanical crimping or snap-together seams with concealed clips and fasteners.

Smooth, flat Surface Texture.

2.4.3 Foam-Insulation Core Wall Panel

Provide factory-formed aluminum or steel roof wall panel assembly fabricated from two sheets of metal with modified polyisocyanurate or polyurethane foam insulation core foamed-in-place during fabrication with joints between panels designed to form weather-tight seals. Include accessories required for weather-tight installation.

a. Closed-Cell Content: 90 percent when tested according to ASTM D6226, ASTM C1289.

b. Density: 2.0 to 2.6 lb/cu. ft. when tested according to ASTM D1622.

c. Compressive Strength: Minimum 20 psi when tested according to ASTM D1621.

d. Shear Strength: 26 psi when tested according to ASTM C273/C273M.

2.4.4 Insulated Panel Construction

Shop fabricate or field assemble insulated panel construction with specified exterior and interior aluminum or steel sheet in accordance with manufacturer's printed instructions.

Insulation to be glass-fiber-ASTM C991or slag-wool-fiber or rock-wool-fiber conforming to ASTM C553 and ASTM C612 of thickness and density as required for the geographical area where construction will take place. Glass-Fiber and Mineral-Wool-Fiber are materials listed in the EPA's Comprehensive Procurement Guidelines (CPG) (http://www.epa.gov/cpg/), and are a component of sustainable acquisition compliance.

Insulation fasteners to be adhesively attached, plate welded to projecting spindle anchors; capable of holding insulation of thickness indicated, secured in position with self-locking washer and complying with the following requirements:

a. Plate: Perforated galvanized carbon-steel sheet 0.030 inch thick by 2 inches square.

b. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.

c. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.

d. Anchor adhesive to be a product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

2.4.5 Finish

All panels are to receive a factory-applied Kynar 500/Hylar 5000 finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat conforming to the following:

a. Metal Preparation: All metal is to have the surfaces carefully prepared for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with acid rinse, and thorough drying.

b. Prime Coating: A base coat of epoxy paint, specifically formulated to interact with the top-coat, is to be applied to the prepared surfaces by roll coating to a dry film thickness of 0.20 plus 0.05 mils. This prime coat must be oven cured prior to application of finish coat.

c. Exterior Finish Coating: Apply the finish coating over the primer by roll coating to dry film thickness of 0.80 plus 5 mils (3.80 plus 0.50 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 plus 0.10 mils (4.00 plus 0.10 mils for Vinyl Plastisol). This finish coat must be oven-cured.

d. Interior Finish Coating: Apply a wash-coat on the reverse side over the primer by roll coating to a dry film thickness of 0.30 plus 0.05 mils for a total dry film thickness of 0.50 plus 0.10 mils. The wash-coat must be oven-cured.

e. Color: The exterior finish chosen from the manufacturer's color charts and chips.

f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

Chalking: ASTM DEFONLINE
Color Change and Conformity: ASTM D2244
Weatherometer: ASTM G152, ASTM G153 and ASTM D822
Humidity: ASTM D2247 and ASTM D714
Salt Spray: ASTM B117
Chemical Pollution: ASTM D1308
Gloss at 60 degrees: ASTM D523
Pencil Hardness: ASTM D3363
Reverse Impact: ASTM D2794
Flexibility: ASTM D522
Abrasion: ASTM D968
Flame Spread: ASTM E84

2.4.6 Repair Of Finish Protection

Repair paint for color finish enameled metal panel must be compatible paint of the same formula and color as the specified finish furnished by the metal panel manufacturer, conforming to ASTM A780/A780M.

2.5 MISCELLANEOUS METAL FRAMING

2.5.1 General

Cold-formed metallic-coated steel sheet conforming to ASTM A653/A653M

2.5.2 Fasteners for Miscellaneous Metal Framing

Refer to the following paragraph "FASTENERS".

2.6 FASTENERS

2.6.1 General

Type, material, corrosion resistance, size and sufficient length to penetrate the supporting member a minimum of 1 inch with other properties required to fasten miscellaneous metal framing members to substrates in accordance with the metal panel manufacturer's and ASCE 7 requirements.

2.6.2 Exposed Fasteners

Fasteners for metal panels to be corrosion resistant coated steel, aluminum, stainless steel, or nylon capped steel compatible with the sheet panel or flashing and of a type and size recommended by the manufacturer to meet the performance requirements and design loads. Fasteners for accessories to be the manufacturer's standard. Provide an integral metal washer matching the color of attached material with compressible sealing EPDM gasket approximately 3/32 inch thick.

2.6.3 Screws

Screws to be corrosion resistant coated steel, aluminum and/or stainless steel being the type and size recommended by the manufacturer to meet the performance requirements.

2.6.4 Rivets

Rivets to be closed-end type, corrosion resistant coated steel, aluminum or stainless steel where watertight connections are required.

2.6.5 Attachment Clips

Fabricate clips from steel hot-dipped galvanized in accordance with ASTM A653/A653M or Series 300 stainless steel. Size, shape, thickness and capacity as required meeting the insulation thickness and design load criteria specified.

2.7 FRAMES AND MATERIALS FOR OPENINGS

2.7.1 Doors

Fire-Rated and Non-Fire-Rated Door Assemblies conforming with NFPA 80 and based on testing according to NFPA 252 as specified in Division 08 - OPENINGS unless other wise indicated.

2.8 ACCESSORIES

2.8.1 General

All accessories to be compatible with the metal panels; sheet metal flashing, trim, metal closure strips, caps and similar metal accessories must not be less than the minimum thickness specified for the metal panels. Exposed metal accessories/finishes to match the panels furnished, except as otherwise indicated. Molded foam rib, ridge and other closure strips to be non-absorbent closed-cell or solid-cell synthetic rubber or pre-molded neoprene to match configuration of the panels.

2.8.2 Roof and Wall Accessories and Specialties

Aluminum or Steel roof curbs, equipment supports, roof hatches, dropout-type heat and smoke vents, hatch-type heat and smoke vents, gravity and roof ridge ventilators, wall louvers and other miscellaneous roof and wall equipment or penetrations conforming to AAMA, ASTM, and UL as specified in Division 07 unless other wise indicated.

2.8.3 Insulation

Faced, Glass-Fiber Blanket Insulation: ASTM C665, Type III, blankets with reflective coverings; Class A, membrane-faced surface with a flame spread of 25 or less and a smoke developed rating of 150 or lesswhen tested in accordance with ASTM E84.

2.8.3.1 Polyethylene Vapor Retarder

Install polyethylene vapor retarder membrane over entire wall and roof surface. Use fully compatible polyethylene tape to seal the edges of the sheets to provide a vapor tight membrane. Lap sheets not less than 6 inch. Provide sufficient material to avoid inducing stresses in sheets due to stretching or binding. All tears or punctures visible in the finished surface, at anytime during the construction process, must be sealed with polyethylene tape.

2.8.3.2 Wall Liner

Securely fasten wall liner into place in accordance with the manufacturer's recommendation and in a neatly presented appearance.

2.8.4 Rubber Closure Strips

Closed-cell, expanded cellular rubber conforming to ASTM D1056 and ASTM D1667; extruded or molded to the configuration of the specified metal panel and in lengths supplied by the metal panel manufacturer.

2.8.5 Metal Closure Strips

Factory fabricated aluminum or steel closure strips to be the same gauge thickness, color, finish and profile of the specified roof or wall panel.

2.8.6 Joint Sealants

2.8.6.1 Sealants

Sealants are to be an approved gun type for use in hand or air-pressure caulking guns at temperatures above 40 degrees F(or frost-free application at temperatures above 10 degrees F with minimum solid content of 85 percent of the total volume. Sealant is to dry with a tough, durable surface skin which permits it to remain soft and pliable underneath, providing a weather-tight joint. No migratory staining is permitted on painted or unpainted metal, stone, glass, vinyl, or wood.

Prime all joints to receive sealants with a compatible one-component or two-component primer as recommended by the metal panel manufacturer.

2.8.6.2 Shop-Applied

Sealant for shop-applied caulking must be an approved gun grade, non-sag one component polysulfide or silicone conforming to ASTM C920, Type II, and with a curing time to ensure the sealant's plasticity at the time of field erection.

2.8.6.3 Field-Applied

Sealant for field-applied caulking must be an approved gun grade, non-sag one component polysulfide or two-component polyurethane with an initial maximum Shore A durometer hardness of 25, and conforming to ASTM C920, Type II. Color to match panel colors.

2.8.6.4 Tape Sealant

Pressure sensitive, 100 percent solid with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the metal panel manufacturer.

2.9 SHEET METAL FLASHING AND TRIM

2.9.1 Fabrication

Shop fabricate sheet metal flashing and trim where practicable to comply with recommendations in SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

2.10 FINISHES

2.10.1 General

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

2.10.2 Appearance of Finished Work

Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 EXAMINATION

Before erection proceeds examine with the erector present the concrete foundation dimensions, concrete and/or masonry bearing surfaces, anchor bolt size and placement, survey slab elevation, locations of bearing plates, and other embedment's to receive structural framing with the metal building manufacturer's templates and drawings before erecting any steel components for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

Examine primary and secondary framing to verify that rafters, purlins, angles, channels, and other structural and metal panel support members and anchorages have been installed within alignment tolerances required by metal building manufacturer, UL, ASTM, ASCE 7 and as required by the building code for the geographical area where construction will take place.

Examine roughing-in for components and systems penetrating metal roof or wall panels to verify actual locations of penetrations relative to seam locations of metal panels before metal roof or wall panel installation.

Submit to the Contracting Officer a written report, endorsed by Erector, listing conditions detrimental to performance of the Work.

Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Provide temporary shoring, guys, braces, and other supports during erection to keep the structural framing secure, plumb, and in alignment against temporary construction loading or loads equal in intensity of the building design loads. Remove temporary support systems when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.

Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment and performance.

Miscellaneous Framing: Install sub-purlins, girts, angles, furring, and other miscellaneous support members or anchorage for the metal roof or wall panels, doors, windows, roof curbs, ventilators and louvers according to metal building manufacturer's written instructions.

3.3 ERECTION OF STRUCTURAL FRAMING

Erect metal building system according to manufacturer's written erection instructions, approved shop drawings and other erection documents in accordance with MBMA MBSM - "Metal Building Systems Manual".

Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer and the Contracting Officer.

Set structural framing accurately in locations and to elevations indicated and according to AISC 325 specifications. Maintain structural stability of frame during erection.

Clean and roughen concrete and masonry bearing surfaces prior to setting plates. Clean bottom surface of plates.

Align and adjust structural framing before permanent bolt-up and connections. Perform necessary adjustments and alignment to compensate for changes or discrepancies in elevations.

Maintain erection tolerances of structural framing in accordance with AISC 360.

3.4 METAL WALL PANEL INSTALLATION

Provide metal wall panels of full length from sill to eave as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal wall panels and other components of the Work securely in place, in accordance with MBMA MBSM.

Erect wall panel system in accordance with the approved erection drawings, the printed instructions and safety precautions of the metal building manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Do not install bent, chipped, or defective sheets.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated eave, and sill.

Work is to allow for thermal movement of the wall panel, movement of the building structure, and to provide permanent freedom from noise due to wind pressure.

Field cutting metal wall panels by torch is not permitted.

3.5 ROOF PANEL INSTALLATION

Provide metal roof panels of full length from eave to ridge or eave to wall as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work

securely in place in accordance with NRCA RoofMan and MBMA MBSM.

Erect roofing system in accordance with the approved erection drawings, the printed instructions and safety precautions of the metal building manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Do not install bent, chipped, or defective sheets.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated rake and eave overhang.

Work must allow for thermal movement of the roofing, movement of the building structure, and provide permanent freedom from noise due to wind pressure.

Field cutting metal roof panels by torch is not permitted.

Roofing sheets must be laid with corrugations in the direction of the roof slope. End laps of exterior roofing must not be less than 8 inches; the side laps of standard exterior corrugated sheets must not be not less than 2-1/2 corrugations.

Do not permit storage, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to the installed roofing materials, and to distribute weight to conform to the indicated live load limits of roof construction.

3.6 METAL PANEL FASTENER INSTALLATION

Anchor metal panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.7 FLASHING, TRIM AND CLOSURE INSTALLATION

a. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

b. Sheet metalwork is to be accomplished to form weather-tight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades is to be performed by sheet metal mechanics.

3.8 DOOR AND FRAME INSTALLATION

Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturer's written instructions. Coordinate installation with metal panel flashings and other components. Caulk and seal perimeter of each door frame with elastomeric sealant compatible with metal panels. Comply with installation requirements in Division 08 - OPENINGS.

3.9 WINDOW INSTALLATION

Install windows plumb, rigid, properly aligned, without warp or rack of frames or sash, and securely fastened in place according to manufacturer's written instructions. Coordinate installation with metal panel flashings and other components. Caulk and seal perimeter of each window frame with elastomeric sealant compatible with for metal panels.Comply with installation requirements in Division 08 - OPENINGS.

3.10 ACCESSORY INSTALLATION

3.10.1 General

Install accessories with positive anchorage to building and weather-tight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

3.10.2 Dissimilar Metals

Where dissimilar metals contact one another or corrosive substrates are present, protect against galvanic action by painting dissimilar metal surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each surface, or by other permanent separation techniques as recommended by the metal building manufacturer.

3.10.3 Gutters and Downspouts

Comply with performance requirements, manufacturer's written installation instructions, and install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA 1793 recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

3.10.4 Insulation

Comply with performance requirements and manufacturer's written installation instructions. Install insulation concurrently with metal panel installation, in thickness indicated to cover entire roof and wall area, as specified in Division 07 - THERMAL AND MOISTURE PROTECTION.

3.10.5 Roof and Wall Accessories and Specialties

Install roof and wall accessories and specialties complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports as specified in Division 07 - THERMAL AND MOISTURE PROTECTION, unless other wise indicated.

3.11 CLEAN-UP AND PROTECTION

3.11.1 Structural Framing

Clean all exposed structural framing at completion of installation. Remove metal shavings, filings, bolts, and wires from work area. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces to be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

3.11.2 Metal Panels

Clean all exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from work area. Remove protective coverings/films, grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces to be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

3.11.3 Touch-Up Painting

After erection, promptly clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories. Clean and touch-up paint with manufacturer's touch-up paint.

3.12 WASTE MANAGEMENT

Separate waste in accordance with the Waste Management Plan, placing copper materials, ferrous materials, and galvanized sheet metal in designated areas for reuse. Close and seal tightly all partly used adhesives and solvents; store protected in a well-ventilated, fire-safe area at moderate temperature.

Collect and place scrap/waste debris in containers. Promptly dispose of scrap/waste debris. Do not allow scrap/waste debris to accumulate on-site; transport scrap/waste debris from government property and legally dispose of them.

3.13 WARRANTY

3.13.1 MANUFACTURER'S WARRANTY

Submit all manufacturers' signed warranties to Contracting Officer prior to final commissioning and acceptance.

3.13.2 CONTRACTOR'S WARRANTY for INSTALLATION

Submit contractor's warranty for installation to the Contracting Officer prior to final commissioning and acceptance.

3.13.3 CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM

FACILITY DESCRIPTION:_____

BUILDING NUMBER:_____

CORPS OF ENGINEERS CONTRACT NUMBER:_____

CONTRACTOR

CONTRACTOR:_____
ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

OWNER

OWNER:_____
ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONSTRUCTION AGENT

CONSTRUCTION AGENT:_____
ADDRESS:_____

POINT OF CONTACT:_____
_
TELEPHONE NUMBER:_____

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(continued)

THE METAL BUILDING SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY Contractor FOR A PERIOD OF FIVE 20 YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE AND STRUCTURAL FAILURE WITHIN PROJECT SPECIFIED DESIGN LOADS, AND LEAKAGE. THE METAL BUILDING SYSTEM COVERED UNDER THIS WARRANTY INCLUDES, BUT IS NOT LIMITED TO, THE FOLLOWING:

FRAMING AND STRUCTURAL MEMBERS, ROOFING AND SIDING PANELS AND SEAMS, INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS, ACCESSORIES, TRIM, FLASHINGS AND MISCELLANEOUS BUILDING CLOSURE ITEMS SUCH AS DOORS AND WINDOWS (WHEN FURNISHED BY THE MANUFACTURER), CONNECTORS, COMPONENTS, AND FASTENERS, AND OTHER SYSTEM COMPONENTS AND ASSEMBLIES INSTALLED TO PROVIDE A WEATHERTIGHT SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THESE SPECIFICATIONS THAT BECOME PART OF THE METAL BUILDING SYSTEM.

ALL MATERIAL AND WORKMANSHIP DEFICIENCIES, SYSTEM DETERIORATION CAUSED BY EXPOSURE TO THE ELEMENTS AND/OR INADEQUATE RESISTANCE TO SPECIFIED SERVICE DESIGN LOADS, WATER LEAKS AND WIND UPLIFT DAMAGE MUST BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE AND LEAKAGE ASSOCIATED WITH THE METAL BUILDING SYSTEM COVERED UNDER THIS WARRANTY MUST BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER.

THIS WARRANTY COVERS THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

_____

(Company President) (Date)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(continued)

THE CONTRACTOR HEREBY SUPPLEMENTS THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE METAL BUILDING SYSTEM, WHICH IS SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR IS ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).

2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL,INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.

3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.

4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.

5. FAILURE OF ANY PART OF THE BUILDING SYSTEM DUE TO ACTIONS BY THE OWNER WHICH INHIBIT FREE DRAINAGE FROM THE ROOF, GUTTERS AND DOWNSPOUTS; OR CONDITIONS WHICH CREATE PONDING WATER ON THE ROOF OR AGAINST THE BUILDING SIDING.

6. THIS WARRANTY APPLIES TO THE METAL BUILDING SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.

7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR AND THIS WARRANTY AND THE CONTRACT PROVISIONS TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES. REPORTS OF LEAKS AND BUILDING SYSTEM DEFICIENCIES MUST BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE BY TELEPHONE OR IN WRITING FROM EITHER THE OWNER, OR CONTRACTING OFFICER. EMERGENCY REPAIRS, TO PREVENT FURTHER ROOF LEAKS, MUST BE INITIATED IMMEDIATELY; A WRITTEN PLAN MUST BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS SSSMR SYSTEM WITHIN SEVEN CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT MUST BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(Exclusions from Coverage Continued)

IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE METAL BUILDING SYSTEM REPLACED OR REPAIRED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR. IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT, THE CONTRACTOR MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION, UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED THE PARTIES MUST, WITHIN 10 DAYS JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES MUST CONFER WITHIN 10 DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY UNTIL ONE NAME REMAINS. THE REMAINING PERSON WILL BE THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED ETC., MUST BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT MUST PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE. A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NOT LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT.

POST A FRAMED COPY OF THIS WARRANTY IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS
07/06

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.

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2012; Errata 2012; INT 1 2012; INT 2 2012; INT 3 2012) National Electrical Safety Code
IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to all sections of Division 26, ELECTRICAL, of this project specification unless specified otherwise in the individual sections. This section has been incorporated into, and thus, does not apply to, and is not referenced in the following sections.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 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.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 12.47 kV primary, three phase, three wire, 60 Hz, and 480/277 volts secondary, three phase, four wire. Final connections to the power distribution system at the existing substation shall be made by the Contractor as directed by the Contracting Officer.

1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.5.1 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.

1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.6 QUALITY ASSURANCE

1.6.1 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.

1.6.2 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.

1.6.2.1 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.

1.6.2.2 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.

1.7 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.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment

enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.11 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers and pad-mounted SF6 switches, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

1.12 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.13 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.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements specified in the technical sections.

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.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

-- End of Section --

SECTION 26 05 00.00 40

COMMON WORK RESULTS FOR ELECTRICAL
11/10

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 D709	(2001; R 2007) Laminated Thermosetting Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 480	(1981) Toggle Switches

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI Z535.1	(2006; R 2011) American National Standard for Safety--Color Code
ANSI/NEMA OS 1	(2008; Amd 2010) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA FB 1	(2012) 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 V Maximum)

NEMA PB 1	(2011) Panelboards
NEMA RN 1	(2005) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2003) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2004) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA VE 1	(2009) Standard for Metal Cable Tray Systems
NEMA WD 6	(2002; R 2008) Wiring Devices Dimensions Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jul 2012) Standard for Flexible Metal Conduit
UL 1242	(2006; Reprint Jul 2012) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 489	(2009; Reprint Jun 2011) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 506	(2008; Reprint Oct 2012) Specialty Transformers
UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 797	(2007) Electrical Metallic Tubing -- Steel
UL 870	(2008) Standard for Wireways, Auxiliary Gutters, and Associated Fittings

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 Stds Dictionary.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. Vertical assembly: A vertical assembly is a pole, tower or other such support, mounting hardware, arms, brackets and the load. Load can be a luminaire, siren, loudspeaker or other device. All components of a vertical assembly will be rated by the manufacturer to withstand 135 mph wind loading.

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-03 Product Data

Submit manufacturer's catalog data for the following items:

Conduits, Raceway sand Fittings; G
Wire and Cable; G
Splices and Connectors; G
Switchgears; G
Transformers; G
Interrupt Switches; G
Circuit Breakers; G
Panelboards; G
Lamps and Lighting Fixtures; G
Spare Parts; G
Certification

SD-06 Test Reports

Continuity Test
Phase-Rotation Tests
Insulation Resistance Test

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions.

1.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.5 PREVENTION OF CORROSION

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to

chemical and/or abrasive action), and all outdoor installations. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by approved fittings and treatment. Ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous spare parts not of corrosion-resistant steel shall be hot-dip galvanized except where other equivalent protective treatment is specifically approved in writing.

1.6 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.

1.7 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.

1.8 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.

1.9 FIELD FABRICATED NAMEPLATES

ASTM D709. 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.

1.10 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers and pad-mounted SF6 switches, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

PART 2 PRODUCTS

2.1 MATERIALS

Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

2.1.1 Rigid Steel Conduit

Rigid steel conduit shall comply with UL 6 and be galvanized by the hot-dip process. Rigid steel conduit shall be polyvinylchloride (PVC) coated in accordance with NEMA RN 1, where underground and in corrosive areas, or must be painted with bitumastic.

Fittings for rigid steel conduit shall be threaded.

Gaskets shall be solid. Conduit fittings with blank covers shall have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Covers shall have captive screws and be accessible after the work has been completed.

2.1.2 Electrical Metallic Tubing (EMT)

EMT shall be in accordance with UL 797 and be zinc coated steel. Couplings and connectors shall be zinc-coated, raintight, gland compression with insulation throat. Crimp, spring, or setscrew type fittings are not acceptable.

2.1.3 Flexible Metallic Conduit

Flexible metallic conduit shall comply with UL 1 and be galvanized steel.

Fittings for flexible metallic conduit shall be specifically designed for such conduit.

Provide liquidtight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Specifically design fittings for liquidtight flexible metallic conduit for such conduit.

2.1.4 Intermediate Metal Conduit

Intermediate metal conduit shall comply with UL 1242 and be galvanized.

2.1.5 Rigid Nonmetallic Conduit

Rigid nonmetallic conduit shall comply with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 40.

2.1.6 Wireways and Auxiliary Gutters

Wireway and auxiliary gutters shall be a minimum 4-by 4 inch trade size conforming to UL 870.

2.1.7 Cable Trays

Provide ladder type cable trays conforming to NEMA VE 1.

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.

Conductors installed in plenums shall be marked plenum rated.

2.3 SPLICES AND CONNECTORS

Make all splices in AWG No.8 and smaller with approved insulated electrical type.

Make all splices in AWG No. 6 and larger with 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 ANSI Z535.1.

2.4.2 Toggle Switches

Toggle switches shall comply with EIA 480, control incandescent, mercury, and fluorescent lighting fixtures and be of the heavy duty, general purpose, noninterchangeable flush-type.

Toggle switches shall be commercial grade toggle type, single -pole, three -way two-position devices rated 20 amperes at 277 volts, 60 hertz alternating current (ac) only.

All toggle switches shall be products of the same manufacturer.

2.5 RECEPTACLES

Receptacles shall be commercial grade, 20A, 125 VAC, 2-pole, 3-wire duplex conforming to NEMA WD 6, NEMA 5-20R.

2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES

Outlet boxes for use with conduit systems shall be in accordance with NEMA FB 1 and ANSI/NEMA OS 1 and be not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

2.7 PANELBOARDS

Lighting and appliance branch circuit panelboards shall be the circuit-breaker type in accordance with NEMA PB 1. Bolt circuit breakers to the bus. Plug-in circuit breakers are not acceptable. Buses shall be copper of the rating indicated, with main lugs or main circuit breaker as indicated. Provide all panelboards for use on grounded ac systems with a full-capacity isolated neutral bus and a separate grounding bus bonded to the panelboard enclosure. Panelboard enclosures shall be NEMA 250, Type 1, in accordance with NEMA PB 1. Provide enclosure fronts with latchable hinged doors.

2.8 CIRCUIT BREAKERS

Circuit-breaker interrupting rating shall be not less than those indicated and in no event less than 20,000 amperes root-mean-square (rms) symmetrical at 208 volts, respectively. Multipole circuit breakers shall be the common-trip type with a single handle. Molded case circuit breakers shall be bolt-on type conforming to UL 489.

2.9 LAMPS AND LIGHTING FIXTURES

Manufacturers and catalog numbers shown are indicative of the general type

desired and are not intended to restrict the selection to fixtures of any particular manufacturer. Fixtures with the same salient features and equivalent light distribution and brightness characteristics, of equal finish and quality, are acceptable. Provide lamps of the proper type and wattage for each fixture.

Ballasts shall be high power factor and be energy efficient. Ballasts shall have a Class P terminal protective device for 120 -volt operation as indicated and be rapid-start fluorescent. Ballasts shall be "A" sound rated. Fluorescent lamps shall be standard reduced wattage type.

High intensity discharge (HID) lighting fixtures shall have prewired integral ballasts and cast aluminum housings complete with tempered glass lenses suitable for installation in damp or wet locations. Provide fixtures and lamps.

2.10 DRY-TYPE DISTRIBUTION TRANSFORMERS

General purpose dry-type transformers with windings 600 volts or less shall be two-winding, 60 hertz, self-cooled in accordance with UL 506. Windings shall have a minimum of two 2-1/2-percent taps above and below nominal voltage.

PART 3 EXECUTION

3.1 CONDUITS, RACEWAYS AND FITTINGS

Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or be replaced.

Conduit and raceway runs concealed in or behind walls, above ceilings, or exposed on walls and ceilings 5 feet or more above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

3.1.1 Rigid Steel Conduit

Make field-made bends and offsets with approved hickey or conduit bending machine. Conduit elbows larger than 2-1/2 inches shall be long radius.

Provide all conduit stubbed-up through concrete floors for connections to free-standing equipment with the exception of motor-control centers, cubicles, and other such items of equipment, with a flush coupling when the floor slab is of sufficient thickness. Otherwise,provide a floor box set flush with the finished floor. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.

3.1.2 Electrical Metallic Tubing (EMT)

EMT shall be grounded in accordance with NFPA 70, using pressure grounding connectors especially designed for EMT.

3.1.3 Flexible Metallic Conduit

Use flexible metallic conduit to connect recessed fixtures from outlet boxes in ceilings, transformers, and other approved assemblies.

Bonding wires shall be used in flexible conduit as specified in NFPA 70, for all circuits. Flexible conduit shall not be considered a ground conductor.

Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit.

Liquidtight flexible metallic conduit shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

3.1.4 Intermediate Conduit

Make all field-made bends and offsets with approved hickey or conduit bending machine. Use intermediate metal conduit only for indoor installations.

3.1.5 Rigid Nonmetallic Conduit

Rigid PVC conduit shall be direct buried.

A green insulated copper grounding conductor shall be in conduit with conductors and be solidly connected to ground at each end. Grounding wires shall be sized in accordance with NFPA 70.

3.1.6 Wireway and Auxiliary Gutter

Straight sections and fittings shall be bolted together to provide a rigid, mechanical connection and electrical continuity. Dead ends of wireways and auxiliary gutters shall be closed. Plug all unused conduit openings.

Wireways for overhead distribution and control circuits shall be supported at maximum 5-foot intervals.

Auxiliary gutters used to supplement wiring spaces for equipment not contained in a single enclosure shall contain no switches, overcurrent devices, appliances, or apparatus and be not more than 8 feet long.

3.1.7 Surface Raceways and Assemblies

Surface raceways shall be mounted plumb and level, with the base and cover secured. Minimum circuit run shall be three-wire with one wire designated as ground.

3.2 WIRING

Feeder and branch circuit conductors shall be color coded as follows:

CONDUCTOR	COLOR AC
Phase A	Block
Phase B	Red
Phase C	Blue

CONDUCTOR	COLOR AC
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 4 feet above floor level, when possible.

3.4 WIRING DEVICES

3.4.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates will be aligned vertically to within 1/8 inch.

Ground terminal of each flush-mounted receptacle shall be bonded to the outlet box with an approved green bonding jumper when used with dry wall type construction.

3.4.2 Device Plates

Device plates for switches that are not within sight of the loads controlled shall be suitably engraved with a description of the loads.

Device plates and receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets shall be suitably marked, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Required marking shall consist of a self-adhesive label having 1/4 inch embossed letters.

Device plates for convenience outlets shall be similarly marked indicating the supply panel and circuit number.

3.5 BOXES AND FITTINGS

Furnish and install pullboxes where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right-angle bends shall have a pullbox installed at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

3.6 LAMPS AND LIGHTING FIXTURES

Install new lamps of the proper type and wattage in each fixture. Securely fasten fixtures and supports to structural members and install parallel and perpendicular to major axes of structures.

3.7 PANELBOARDS

Securely mount panelboards so that the top operating handle does not exceed 72-inches above the finished floor. Do not mount equipment within 36 inches of the front of the panel. Directory card information shall be complete and legible.

3.8 DRY-TYPE DISTRIBUTION TRANSFORMERS

Connect dry-type transformers with flexible metallic conduit.

3.9 IDENTIFICATION PLATES AND WARNINGS

Furnish and install identification plates for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, door bells, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Process control devices and pilot lights shall have identification plates.

Furnish identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. Circuits 480 volts and above shall have conspicuously located warning signs in accordance with OSHA requirements.

3.10 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted.

3.11 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Submit Test Reports in accordance with referenced standards in this section.

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Contractor shall provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices shall be used to

isolate the circuits under test.

Perform insulation-resistance test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes 8AWG and smaller insulation resistance testing is not required.

Perform continuity test to insure correct cable connection (i.e correct phase conductor, grounded conductor, and grounding conductor wiring) end-to end. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at contractor's expense. All repairs shall be approved by the CO prior to acceptance of the repair.

Conduct phase-rotation tests on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment clockwise, facing the source.

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the CO.

-- End of Section --

SECTION 26 05 48.00 10

SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT
10/07

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 INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2011) Steel Construction Manual

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04 (2012) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL 1598 (2008; Reprint Oct 2012) Luminaires

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the electrical equipment and systems listed below.

1.2.2 Electrical Equipment

Electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

Interrupt Switch
Automatic Transfer Switch
Switchgear
Transformers
Switchboards (Floor Mounted)

1.2.3 Electrical Systems

The following electrical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification.

1.2.4 Contractor Designed Bracing

Submit copies of the Design Calculations with the Drawings. Calculations shall be approved, certified, stamped and signed by a Registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace. Design the bracing in accordance with UFC 3-310-04 and additional data furnished by the Contracting Officer. Resistance to lateral

forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. UFC 3-310-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using UFC 3-310-04 are based on strength design; therefore, AISC 325 shall be used for the design. The bracing for the following electrical equipment and systems shall be developed by the Contractor: Conduit systems greater than or equal to 2 1/2 inches trade size.

1.2.5 Conduits Requiring No Special Seismic Restraints

Seismic restraints may be omitted from electrical conduit less than 2-1/2 inches trade size. All other interior conduit, shall be seismically protected as specified.

1.3 EQUIPMENT REQUIREMENTS

Submit detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail, indicating thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction. Submit copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.3.1 Rigidly Mounted Equipment

The following specific items of equipment: to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in UFC 3-310-04. Each item of rigid electrical equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

Transformers
Switch Boards
Interrupt Switches
Automatic Transfer Switches

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

Switchboards; G
Interrupt Switches; G
Automatic Transfer Switches; G
Transformers; G

SD-03 Product Data

Contractor Designed Bracing; G

PART 2 PRODUCTS

2.1 LIGHTING FIXTURE SUPPORTS

Lighting fixtures and supports shall conform to UL 1598.

PART 3 EXECUTION

-- End of Section --

SECTION 26 08 00

APPARATUS INSPECTION AND TESTING
08/08

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.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

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 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-06 Test Reports

Acceptance tests and inspections; G

SD-07 Certificates

Qualifications of organization, and lead engineering technician; G
Acceptance test and inspections procedure; G

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.

b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.4.2 Acceptance Tests and Inspections Reports

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

1.4.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Contracting Officer shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

a. Section 26 12 19.00 40 PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS
b. Section 26 36 23.00 20 AUTOMATIC TRANSFER SWITCHES
c. Section 26 23 00 SWITCHBOARDS AND SWITCHGEAR

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion

of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

-- End of Section --

SECTION 26 12 19.00 40

PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS
02/11

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.

ASTM INTERNATIONAL (ASTM)

ASTM A167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM D1535	(2012a) Specifying Color by the Munsell System
ASTM D877	(2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D92	(2012) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM D97	(2011) Pour Point of Petroleum Products

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386	(2006; INT 1 2011) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE C2	(2012; Errata 2012; INT 1 2012; INT 2 2012; INT 3 2012) National Electrical Safety Code
IEEE C37.47	(2011) Standard for High Voltage Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches
IEEE C57.12.00	(2010) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity

IEEE C57.12.34	(2009) Standard for Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 5 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15 kV Nominal System Voltage and Below
IEEE C57.12.80	(2010) Standard Terminology for Power and Distribution Transformers
IEEE C57.12.90	(2010) Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.98	(2011) Guide for Transformer Impulse Tests
IEEE C62.11	(2005; Amd 1 2008) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	(2008) Electric Meters Code for Electricity Metering

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

OECD Test 203	(1992) Fish Acute Toxicity Test

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-90/027F	(1993) Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms
EPA 712-C-98-075	(1996) Fate, Transport and Transformation Test Guidelines - OPPTS 835.3100- "Aerobic Aquatic Biodegradation"

UNDERWRITERS LABORATORIES (UL)

UL 467 (2007) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Stds Dictionary.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

a. Routine and other tests (in PART 2, see paragraph entitled "Routine and Other Tests"), shall be conducted by the manufacturer and may be witnessed by the government (in Part 2, see paragraph entitled "Source Quality Control"). Provide transformer test schedule required by submittal item "SD-11 Closeout Submittals". Provide certified copies of the tests.

b. Provide acceptance test reports required by submittal item "SD-06 Test Reports".

c. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data".

SD-02 Shop Drawings

Pad-Mounted Transformer Drawings; G

SD-03 Product Data

Pad-Mounted Transformers; G

Submittal shall include manufacturer's information for each component, device, and accessory provided with the transformer.

SD-06 Test Reports

Acceptance Checks And Tests; G

SD-07 Certificates

Transformer Losses; G

Submit certification from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Losses."

SD-09 Manufacturer's Field Reports

Pad-mounted transformer Routine And Other Tests; G

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

SD-11 Closeout Submittals

Transformer Test Schedule; G

Submit report of test results as specified by paragraph entitled "Field Quality Control."

1.5 QUALITY ASSURANCE

1.5.1 Pad-Mounted Transformer Drawings

Drawings shall indicate, but not be limited to the following:

a. An outline drawing, with front, top, and side views.

b. ANSI nameplate data.

c. Elementary diagrams and wiring diagrams with terminals identified of watthour meter and current transformers.

d. One-line diagram, including switch(es), current transformers, meters, and fuses.

e. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses.

1.5.2 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.

1.5.3 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.

1.5.3.1 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.

1.5.3.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than 3 years prior to date of delivery to site, unless specified otherwise.

1.5.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.6 MAINTENANCE

1.6.1 Additions to Operation and Maintenance Data

In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

a. An instruction manual with pertinent items and information highlighted

b. An outline drawing, front, top, and side views

c. Prices for spare parts and supply list

d. Routine and field acceptance test reports

e. Fuse curves for primary fuses

f. Information on watthour demand meter, CT's, and fuse block

g. Actual nameplate diagram

h. Date of purchase

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.34, IEEE C57.12.28 and as specified herein.

2.1.1 Compartments

Separate the high- and low-voltage compartments with steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.1.1.1 High Voltage, Dead-Front

High-voltage compartment shall contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, access to oil-immersed fuses, dead-front surge arresters, tap changer handle, connector parking stands with insulated standoff bushings, protective caps, and ground pad.

a. Insulated high-voltage load-break connectors: IEEE 386, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

b. Bushing well inserts: IEEE 386, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise.

c. Load-break switch

   (1) Radial-feed oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

d. Provide bayonet type, oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. Bayonet fuse links shall sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. In order to eliminate or minimize oil spills, the bayonet fuse assembly shall include an oil retention valve inside the housing which closes when the fuse holder is removed and an external drip shield. Conspicuously display warning within the high-voltage compartment cautioning against removing or inserting fuses unless the load-break switch is in the open position and the tank pressure has been released.

   (1) Bayonet fuse assembly: 150 kV BIL.

   (2) Oil-immersed current-limiting fuses: IEEE C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified.

e. Surge arresters: IEEE C62.11, rated 15 kV, fully shielded, dead-front,

metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging into inserts.

f. Parking stands: Provide a parking stand near each bushing well. Provide insulated standoff bushings for parking of energized load-break connectors on parking stands.

g. Protective caps: IEEE 386, 200 amperes, 15 kV Class. Provide insulated protective caps (not shipping caps) for insulating and sealing out moisture from unused bushing well inserts.

2.1.1.2 Low Voltage

Low-voltage compartment shall contain low-voltage bushings with NEMA spade terminals, accessories, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

a. Accessories shall include drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.

2.1.2 Compartment Construction

a. Two compartment: Separate the high- and low-voltage compartments with steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.1.3 Transformer

a. Less-flammable liquid-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.

b. Transformer shall be rated 300 kVA, 95 kV BIL.

c. Transformer voltage ratings: 12,470 V - 480/277 V.

d. Tap changer shall be externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Tap changers shall clearly indicate which tap setting is in use.

e. Minimum tested impedance shall not be less than 4 percent at 85 degrees C on Three-Phase transformers.

f. Audible sound levels shall comply with the following:

kVA	DECIBELS (MAX)
75	51
112.5	55
150	55
225	55
300	55
500	56
750	57
1000	58
1500	60

g. Transformer shall include lifting lugs and provisions for jacking under base. The transformer base construction shall be suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. Transformer shall have its kVA rating conspicuously displayed on its enclosure. The transformer shall have an insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.

2.1.3.1 Specified Transformer Losses

No-load losses (NLL) shall be 490 watts at 20 degrees C and load losses (LL) shall be 2980 watts at 85 degrees C. Use the values for the specified losses for comparison with the losses determined during the routine tests. If the routine test values for no-load losses exceed the specified no-load losses by more than 10 percent, or the total losses exceed the specified total losses (sum of no-load and load losses) by more than 6 percent, the transformer is unacceptable.

2.1.4 Insulating Liquid

a. Less-flammable transformer liquids: NFPA 70 and FM APP GUIDE for less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D92 and a dielectric strength not less than 33 kV tested per ASTM D877. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

(1) The fluid shall be a biodegradable electrical insulating and cooling liquid classified by UL and approved by FM as "less flammable" fluids. The fluid shall meet the following fluid properties:

(a) Pour point: ASTM D97, less than -15 degree C

(b) Aquatic biodegradation: EPA 712-C-98-075, 100%

(c) Trout toxicity: OECD Test 203, zero mortality of EPA 600/4-90/027F, pass

2.1.4.1 Liquid-Filled Transformer Nameplates

Provide distribution transformers with nameplate information in accordance with IEEE C57.12.00 and as modified or supplemented by this section.

2.1.5 Corrosion Protection

Bases and cabinets of transformers shall be corrosion resistant and shall be fabricated of stainless steel conforming to ASTM A167, Type 304 or 304L. Base shall include any part of pad-mounted transformer that is within 3 inches of concrete pad. Paint bases, cabinets, and tanks Munsell 7GY3.29/1.5 green. Paint coating system shall comply with IEEE C57.12.28. The Munsell color notation is specified in ASTM D1535.

2.2 WARNING SIGNS

Provide warning signs for the enclosures of pad-mounted transformers having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, such as for pad-mounted transformers,

provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

2.3 SOURCE QUALITY CONTROL

2.3.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

(1) The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

(2) The accuracy shall be directly traceable to the National Institute of Standards and Technology.

(3) Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.

(4) Dated calibration labels shall be visible on all test equipment.

(5) Calibrating standard shall be of higher accuracy than that of the instrument tested.

(6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

(a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.3.2 Design Tests

IEEE C57.12.00, and IEEE C57.12.90. Section 5.1.2 in IEEE C57.12.80 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the

catalog data and drawings for each of the specified transformer(s). Perform design tests prior to the award of this contract.

a. Tests shall be certified and signed by a registered professional engineer.

b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (ONAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.

c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include the primary windings only of that transformer.

   (1) IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.

   (2) State test voltage levels.

   (3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with IEEE C57.12.34.

e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

f. Short circuit: "Basically the same design" for the short circuit test means a pad-mounted transformer with the same kVA as the transformer specified.

2.3.3 Routine and Other Tests

IEEE C57.12.00. Routine and other tests shall be performed by the manufacturer on the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence shall be as follows:

a. Cold resistance measurements (provide reference temperature)

b. Phase relation

c. Ratio

d. No-load losses (NLL) and excitation current

e. Load losses (LL) and impedance voltage

f. Dielectric

(1) Impulse

(2) Applied voltage

(3) Induced voltage

g. Leak

h. Dissolved gas analysis (DGA)

2.3.4 PREDICTIVE & ACCEPTANCE TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Meters and Current Transformers

ANSI C12.1.

3.4 FIELD APPLIED PAINTING

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.5 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.6 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab. Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Place the slab on a 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade shall have 1/2 inch chamfer. Slab shall be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.6.1 Cast-In-Place Concrete

Cast-in-place concrete work shall conform to the requirements of Section 32 13 00 CAST-IN-PLACE CONCRETE.

3.6.2 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.7 FIELD QUALITY CONTROL

3.7.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.7.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

   (1) Compare equipment nameplate information with specifications and approved shop drawings.

   (2) Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

(3) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(4) Verify correct liquid level in tanks.

(5) Perform specific inspections and mechanical tests as recommended by manufacturer.

(6) Verify correct equipment grounding.

(7) Verify the presence of transformer surge arresters.

b. Electrical tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter.

(2) Verify that the tap-changer is set at specified ratio.

(3) Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3.7.1.2 Current Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection.

(4) Verify that adequate clearances exist between primary and secondary circuit.

(5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(6) Verify that required grounding and shorting connections provide good contact.

b. Electrical tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

(2) Perform insulation-resistance test.

(3) Perform a polarity test.

(4) Perform a ratio-verification test.

3.7.1.3 Grounding System

a. Visual and mechanical inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

(1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. Equip the instrument with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

(2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.7.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM
08/08

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.

ASTM INTERNATIONAL (ASTM)

ASTM B 1	(2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
ASTM B 8	(2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; Errata 2006 & 2007; INT 44-56 2007; INT 47, 49, 50, 52-56 2008; INT 57, 58, 51, 48, 59 2009) 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

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA C80.1	(2005) Standard for Electrical Rigid Steel Conduit (ERSC)
NEMA C80.3	(2005) Standard for Electrical Metallic Tubing (EMT)
NEMA C80.5	(2005) Standard for Electrical Rigid Aluminum Conduit (ERAC)
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 6	(1993; R 2006) Standard for Industrial Controls and Systems Enclosures
NEMA KS 1	(2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA RN 1	(2005) Standard for Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(1992; R 1997) Standard for Dry-Type Transformers for General Applications
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 TP 1	(2002) Guide for Determining Energy Efficiency for Distribution Transformers
NEMA WD 1	(1999; R 2005) Standard for General Requirements for Wiring Devices
NEMA WD 6	(2002; R 2008) Standard for Wiring Devices - Dimensional Requirements
NEMA Z535.4	(2007; Errata 2007) Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2008; AMD 1 2008) National Electrical Code - 2008 Edition
NFPA 70E	(2009; Errata 2009) Standard for Electrical Safety in the Workplace

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA J-STD-607-A	(2002) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

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

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Rev thru Jul 2007) Standard for Flexible Metal Conduit

UL 1242	(2006; Rev thru Jul 2007) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 1449	(2006; Rev thru Sep 2009) Surge Protective Devices
UL 1660	(2004; Rev thru Jan 2005) Liquid-Tight Flexible Nonmetallic Conduit
UL 198M	(2003; Rev thru Oct 2007) Mine-Duty Fuses
UL 20	(2000 ; Rev thru Dec 2008) Standard for General-Use Snap Switches
UL 360	(2009; Rev thru Jun 2009) Liquid-Tight Flexible Steel Conduit
UL 467	(2007) Standard for Grounding and Bonding Equipment
UL 486A-486B	(2003; Rev thru Apr 2009) Standard for Wire Connectors
UL 486C	(2004; Rev thru Apr 2009) Standard for Splicing Wire Connectors
UL 489	(2009) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 498	(2001; Rev thru Jul 2009) Attachment Plugs and Receptacles
UL 50	(2007) Standard for Enclosures for Electrical Equipment
UL 510	(2005; Rev thru Aug 2005) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 512	(1993; Rev thru Jan 2008) Fuseholders
UL 514A	(2004; Rev thru Oct 2009) Standard for Metallic Outlet Boxes
UL 514B	(2004; Rev thru Nov 2009) 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 67	(2009) Standard for Panelboards

UL 6A	(2008) Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel
UL 797	(2007) Standard for Electrical Metallic Tubing -- Steel
UL 83	(20086) Standard for Thermoplastic-Insulated Wires and Cables
UL 854	(2004; Rev thru Oct 2007) Service-Entrance Cables
UL 870	(1995; Rev thru Jul 2003) Standard for Wireways, Auxiliary Gutters, and Associated Fittings

1.2 DEFINITIONS

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.

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

Panelboards; G
Transformers; G
Switchboards; G
Autmatic Transfer Switches; G

SD-03 Product Data

Receptacles; G
Circuit breakers; G
Switches; G
Transformers; G
Enclosed circuit breakers; G
Metering; G

SD-06 Test Reports

600-volt wiring test; G
Grounding system test; G

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 this 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 MAINTENANCE

1.5.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.6 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7 SEISMIC REQUIREMENTS

Seismic details shall conform to Section 26 05 48.00 10, SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

NEMA C80.1, UL 6.

2.2.1.2 Rigid Aluminum Conduit

NEMA C80.5, UL 6A.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, and EPC-80 in accordance with NEMA TC 2,UL 651.

2.2.3 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.2.4 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797, NEMA C80.3.

2.2.5 Plastic-Coated Rigid Steel and IMC Conduit

NEMA RN 1, Type 40(40 mils thick).

2.2.6 Flexible Metal Conduit

UL 1.

2.2.6.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.7 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.7.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.7.2 Fittings for EMT

Steel screw type.

2.2.8 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.2.9 Liquid-Tight Flexible Nonmetallic Conduit

UL 1660.

2.3 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal.

2.4 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.4.1 Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and capacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.4.1.1 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG.

2.4.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. 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

2.4.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.4.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.4.5 Service Entrance Cables

Service Entrance (SE) and Underground Service Entrance (USE) Cables, UL 854.

2.5 SPLICES AND TERMINATION COMPONENTS

UL 486A-486B for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A-486B or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.6 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. For nonmetallic boxes and fittings, other suitable plates may be provided. Plates on finished walls shall be satin finish stainless steel or brushed-finish aluminum, minimum 0.03 inch thick. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

2.7 SWITCHES

2.7.1 Toggle Switches

NEMA WD 1, UL 20, single pole, three-way, and four-way, totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Handles shall be white thermoplastic. Wiring terminals shall be screw-type, side-wired. Contacts shall be silver-cadmium and contact arm shall be one-piece copper alloy. Switches shall be rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.7.2 Switch with Red Pilot Handle

NEMA WD 1. Provide pilot lights that are integrally constructed as a part of the switch's handle. The pilot light shall be red and shall illuminate whenever the switch is closed or "on". The pilot lighted switch shall be rated 20 amps and 120 volts or 277 volts as indicated. Provide the circuit's neutral conductor to each switch with a pilot light.

2.7.3 Breakers Used as Switches

For 120- and 277-Volt fluorescent fixtures, mark breakers "SWD" in accordance with UL 489.

2.7.4 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 1 or 3R, enclosure as indicated per NEMA ICS 6.

2.8 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Submit coordination data for approval. Fuses shall have voltage rating not less than circuit voltage.

2.8.1 Fuseholders

Provide in accordance with UL 512.

2.8.2 Cartridge Fuses, Current Limiting Type (Class R)

UL 198M, Class RK-5 time-delay type. Associated fuseholders shall be Class R only.

2.8.3 Cartridge Fuses, High-Interrupting Capacity, Current Limiting Type (Classes J, L, and CC)

UL 198M, Class J for zero to 600 amperes, Class L for 601 to 6,000 amperes, and Class CC for zero to 30 amperes.

2.8.4 Cartridge Fuses, Current Limiting Type (Class T)

UL 198M, Class T for zero to 1,200 amperes, 300 volts; and zero to 800 amperes, 600 volts.

2.9 RECEPTACLES

UL 498, hard use, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of white as per NEMA WD 1. Face and body shall be thermoplastic supported on a metal mounting strap. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap. The receptacle shall contain triple-wipe power contacts and double or triple-wipe ground contacts.

2.9.1 Switched Duplex Receptacles

Provide separate terminals for each ungrounded pole. Top receptacle shall be switched when installed.

2.9.2 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations with plug in use."

2.10 PANELBOARDS

UL 67 and UL 50 having a short-circuit current rating as indicated. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise. Main breaker shall be "separately" mounted "above" branch breakers. Where "space only" is indicated, make provisions for future installation of breakers. Directories shall indicate load served by each circuit in panelboard. Directories shall also indicate source of service to panelboard (e.g., Panel PA served from Panel MDP). Type directories and mount in holder behind transparent protective covering. Panelboards shall be listed and labeled for their intended use. Panelboard shall have nameplates in accordance with paragraph FIELD FABRICATED NAMEPLATES.

2.10.1 Enclosure

Enclosures shall meet the requirements of UL 50. All cabinets shall be fabricated from sheet steel of not less than No. 10 gauge if flush-mounted or mounted outdoors, and not less than No. 12 gauge if surface-mounted indoors, with full seam-welded box ends. Cabinets mounted outdoors or flush-mounted shall be hot-dipped galvanized after fabrication. Cabinets shall be painted in accordance with paragraph PAINTING. Outdoor cabinets shall be of NEMA 3R raintight. Front edges of cabinets shall be form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front. All cabinets shall be so fabricated that no part of any surface on the finished cabinet shall deviate from a true plane by more than 1/8 inch. Holes shall be provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 1/2 inch clear space between the back of the cabinet and the wall surface. Flush doors shall be mounted on hinges that expose only the hinge roll to view when the door is closed. Each door shall be fitted with a combined catch and lock, except that doors over 24 inches long shall be provided with a three-point latch having a knob with a T-handle, and a cylinder lock. Two keys shall be provided with each lock, and all locks shall be keyed alike. Finished-head cap screws shall be provided for mounting the panelboard fronts on the cabinets.

2.10.2 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet. In addition to equipment grounding bus, provide second "isolated" ground bus, where indicated.

2.10.3 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Where indicated on the drawings, provide circuit breakers with shunt trip devices. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.10.3.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.10.3.2 Circuit Breakers for HVAC Equipment

Circuit breakers for HVAC equipment having motors (group or individual) shall be marked for use with HACR type and UL listed as HACR type.

2.11 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated.

2.12 TRANSFORMERS

NEMA ST 20, general purpose, dry-type, self-cooled, ventilated. Provide transformers in NEMA 1 enclosure. Transformer shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformers shall be quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

2.12.1 Specified Transformer Efficiency

Transformers, indicated and specified with: 480V primary, 80 degrees C or 115 degrees C temperature rise, kVA ratings of 37.5 to 100 for single phase or 30 to 500 for three phase, shall be energy efficient type. Minimum efficiency, based on factory test results, shall not be less than NEMA Class 1 efficiency as defined by NEMA TP 1.

2.13 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 23, "Mechanical."

2.14 GROUNDING AND BONDING EQUIPMENT

2.14.1 Ground Rods

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.14.2 Ground Bus

A copper ground bus shall be provided in the electrical equipment rooms as indicated.

2.15 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.16 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 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.

2.17 WARNING SIGNS

Provide warning signs for flash protection in accordance with NFPA 70E and NEMA Z535.4 for switchboards, panelboards, industrial control panels, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized. Provide field installed signs to warn qualified persons of potential electric arc flash hazards when warning signs are not provided by the manufacturer. The marking shall be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.18 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with Section 07 84 00, FIRESTOPPING.

2.19 WIREWAYS

UL 870. Material shall be steel galvanized 16 gauge for heights and depths up to 6 by 6 inches, and 14 gauge for heights and depths up to 12 by 12 inches. Provide in length required for the application with hinged- cover NEMA 1 enclosure per NEMA ICS 6.

2.20 SURGE PROTECTIVE DEVICES

Provide parallel type surge protective devices which comply with UL 1449 at the service entrance. Provide surge protectors in a NEMA 1 enclosure per NEMA ICS 6. Provide the following modes of protection:

FOR SINGLE PHASE AND THREE PHASE WYE CONNECTED SYSTEMS-
Each phase to neutral (L-N)
Neutral to ground (N-G)
Phase to ground (L-G)

Surge protective devices at the service entrance shall have a minimum surge current rating of 20,000 amperes per mode minimum. The maximum line to neutral (L-N) Suppressed Voltage Rating (SVR) shall be:

900V for 480Y/277V, three phase system

The minimum MCOV (Maximum Continuous Operating Voltage) rating shall be:

600/320V for 480Y/277V, three phase system

2.21 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements as specified herein. Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray, and equipment located outdoors shall be ANSI Light Gray. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

2.22 SOURCE QUALITY CONTROL

2.22.1 Transformer Factory Tests

Submittal shall include routine NEMA ST 20 transformer test results on each transformer and also contain the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces, shall conform to requirements of NFPA 70 and IEEE C2 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

3.1.2.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph FIELD FABRICATED NAMEPLATES. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

3.1.3 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size shall be 3/4 inch in diameter for low voltage lighting and power circuits. Conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors shall be firestopped in accordance with Section 07 84 00, FIRESTOPPING.

3.1.3.1 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.4 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.4.1 Restrictions Applicable to Aluminum Conduit

a. Do not install underground or encase in concrete or masonry.

b. Do not use brass or bronze fittings.

c. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.4.2 Restrictions Applicable to EMT

a. Do not install underground.

b. Do not encase in concrete, mortar, grout, or other cementitious materials.

c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing

equipment could physically damage the EMT.

d. Do not use in hazardous areas.

e. Do not use outdoors.

f. Do not use in fire pump rooms.

g. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.4.3 Restrictions Applicable to Nonmetallic Conduit

a. PVC Schedule 40 and PVC Schedule 80

(1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in fire pump rooms.

(4) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

(5) Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.

(6) Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

(7) Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.4.4 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph FLEXIBLE CONNECTIONS.

3.1.4.5 Service Entrance Conduit, Underground

PVC, Type-EPC 40. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.

3.1.4.6 Underground Conduit Other Than Service Entrance

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40. Convert PVC Schedule 40 or 80, to plastic-coated rigid, steel conduit before rising through floor slab. Plastic coating shall extend minimum 6 inches above floor.

3.1.4.7 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.4.8 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.

3.1.4.9 Conduit Installed in Concrete Floor Slabs

Rigid steel; steel IMC; or PVC, Type EPC-40. Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Do not stack conduits. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends shall not be visible above finish slab. Increase slab thickness as necessary to provide minimum one inch cover over conduit. Where embedded conduits cross building and/or expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings shall allow horizontal and vertical movement of raceway. Conduit larger than one inch trade size shall be parallel with or at right angles to main reinforcement; when at right angles to reinforcement, conduit shall be close to one of supports of slab. Where nonmetallic conduit is used, raceway shall be converted to plastic coated rigid steel or plastic coated steel IMC before rising above floor, unless specifically indicated.

3.1.4.10 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that seal-tight flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.4.11 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems shall be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.4.12 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.13 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.4.14 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 1/2 inch diameter. Provide liquidtight flexible conduit in wet and damp locations for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.5 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and walkways, and when specifically indicated. Boxes in other locations shall be sheet steel, except that aluminum boxes may be used with aluminum conduit. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.5.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet. Telecommunications outlets shall be a minimum of 4 inches square by 2 1/8 inches deep, except for wall mounted telephones and outlet boxes for handicap telephone stations. Mount outlet boxes flush in finished walls.

3.1.5.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.5.3 Extension Rings

Extension rings are not permitted for new construction. Use only on existing boxes in concealed conduit systems where wall is furred out for new finish.

3.1.6 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches and handicapped telecommunications stations 48 inches above finished floor. Mount receptacles and telecommunications outlets 18 inches above finished floor, unless otherwise indicated. Measure mounting heights of wiring devices and outlets in non-hazardous areas to center of device or outlet.

3.1.7 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves.

3.1.7.1 Marking Strips

White or other light-colored plastic marking strips, fastened by screws to each terminal block, shall be provided for wire designations. The wire numbers shall be made with permanent ink. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block. Marking strips shall accommodate the two sets of wire numbers. Each device to which a connection is made shall be assigned a device designation in accordance with NEMA ICS 1 and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block

marking strips may be according to the Contractor's standard practice; however, additional wire and cable designations for identification of remote (external) circuits shall be provided for the Government's wire designations. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.1.8 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.9 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.10 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00, FIRESTOPPING.

3.1.11 Grounding and Bonding

Provide In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. In addition to the requirements specified herein, provide telecommunications grounding in accordance with TIA J-STD-607-A. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.11.1 Ground Rods

Provide cone pointed ground rods. The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 5 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, additional rods not less than 6 feet on centers. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer who will decide on the number of ground rods to add.

3.1.11.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, 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.

3.1.11.3 Ground Bus

A copper ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment.

3.1.11.4 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions.

3.1.12 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.13 Government-Furnished Equipment

Contractor shall make connections to Government-furnished equipment to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

3.1.14 Surge Protective Devices

Connect the surge protective devices in parallel to the power source, keeping the conductors as short and straight as practically possible.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two

sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.4 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Where field painting of enclosures for panelboards, load centers or the like is specified to match adjacent surfaces, to correct damage to the manufacturer's factory applied coatings, or to meet the indicated or specified safety criteria, provide manufacturer's recommended coatings and apply in accordance to manufacturer's instructions.

3.5 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each test.

3.5.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.5.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.5.3 Ground-Fault Receptacle Test

Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.5.4 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

-- End of Section --

SECTION 26 23 00

SWITCHBOARDS
07/06

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.

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 653/A 653M	(2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780/A 780M	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM D 1535	(2008) Specifying Color by the Munsell System
ASTM D 709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; Errata 2006 & 2007; INT 44-56 2007; INT 47, 49, 50, 52-56 2008; INT 57, 58, 51, 48, 59 2009) National Electrical Safety Code
IEEE C37.20.1	(2002; Addenda A 2005; Addenda B 2006; R 2007) Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C57.12.28	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.13	(2008) Standard Requirements for Instrument Transformers
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	(2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C12.1	(2008) Electric Meters; Code for Electricity Metering
NEMA ICS 6	(1993; R 2006) Standard for Industrial Controls and Systems Enclosures
NEMA LI 1	(1998) Industrial Laminated Thermosetting Products
NEMA PB 2	(2006) Deadfront Distribution Switchboards
NEMA PB 2.1	(2007) General Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2008; AMD 1 2008) National Electrical Code - 2008 Edition

UNDERWRITERS LABORATORIES (UL)

UL 1558	(1999; Rev thru Jun 2009) Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
UL 467	(2007) Standard for Grounding and Bonding Equipment
UL 489	(2009) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 891	(2005) Dead-Front Switchboards

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as

defined in IEEE Std 100.

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

Switchboard Drawings; G

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

SD-03 Product Data

Switchboard

SD-10 Operation and Maintenance Data

Switchboard Operation and Maintenance, Data Package 5; G

SD-11 Closeout Submittals

Assembled Operation and Maintenance Manuals; G
Equipment Test Schedule; G
Request for Settings; G

1.5 QUALITY ASSURANCE

1.5.1 Switchboard Product Data

Each submittal shall include manufacturer's information for each component, device and accessory provided with the switchboard including:

a. Circuit breaker type, interrupting rating, and trip devices, including available settings

b. Manufacturer's instruction manuals and published time-current curves (on full size logarithmic paper) of the main secondary breaker and largest secondary feeder device.

1.5.2 Switchboard Drawings

Drawings shall include, but are not limited to the following:

a. One-line diagram including breakers, current transformers, and meters

b. Outline drawings including front elevation, section views, footprint, and overall dimensions

c. Bus configuration including dimensions and ampere ratings of bus bars

d. Markings and NEMA nameplate data

e. Circuit breaker type, interrupting rating, and trip devices, including available settings

f. Three-line diagrams and elementary diagrams and wiring diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.

g. Manufacturer's instruction manuals and published time-current curves (on full size logarithmic paper) of the main secondary breaker and largest secondary feeder device. These shall be used by the designer of record to provide breaker settings that will ensure protection and coordination are achieved.

1.5.3 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.

1.5.4 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.

1.5.4.1 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.

1.5.4.2 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.

1.6 MAINTENANCE

1.6.1 Switchboard Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6.2 Assembled Operation and Maintenance Manuals

Manuals shall be assembled and bound securely in durable, hard covered, water resistant binders. The manuals shall be assembled and indexed in the following order with a table of contents. The contents of the assembled operation and maintenance manuals shall be as follows:

a. Manufacturer's O&M information required by the paragraph entitled "SD-10, Operation and Maintenance Data".

b. Catalog data required by the paragraph entitled, "SD-03, Product Data".

c. Drawings required by the paragraph entitled, "SD-02, Shop Drawings".

d. Prices for spare parts and supply list.

e. Information on metering

f. Design test reports

g. Production test reports

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be switchboards and related accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 SWITCHBOARD

NEMA PB 2 and UL 891IEEE C37.20.1 and UL 1558.

2.2.1 Ratings

The voltage rating of the switchboard shall be volts, as indicated. The continuous current rating of the main bus shall be as indicated. The short-circuit current rating shall be as indicated. The switchboard shall be UL listed and labeled for its intended use for distribution or as service entrance equipment.

2.2.2 Construction

Switchboard shall consist of vertical sections bolted together to form a rigid assembly and shall be rear aligned. All circuit breakers shall be

front accessible. Rear aligned switchboards shall have front accessible load connections. Compartmentalized switchboards shall have vertical insulating barriers between the front device section, the main bus section, and the cable compartment with full front to rear vertical insulating barriers between adjacent sections. Where indicated, "space for future" or "space" shall mean to include bus, device supports, and connections. Provide insulating barriers in accordance with NEMA LI 1, Type GPO-3, 0.25 inch minimum thickness. Apply moisture resistant coating to all rough-cut edges of barriers. Switchboard shall be completely factory engineered and assembled, including protective devices and equipment indicated with necessary interconnections, instrumentation, and control wiring.

2.2.2.1 Enclosure

The switchboard enclosure shall be an outdoor NEMA ICS 6 Type 3R. Enclosure shall be bolted together with removable bolt-on side and rear covers. Bases, frames and channels of enclosure shall be corrosion resistant and shall be fabricated of galvanized steel. Base shall include any part of enclosure that is within 3 inches of concrete pad. Galvanized steel shall be ASTM A 123/A 123M, ASTM A 653/A 653M G90 coating, and ASTM A 153/A 153M, as applicable. Galvanize after fabrication where practicable. Paint enclosure, including bases, ASTM D 1535 light gray No. 61 or No. 49. Paint coating system shall comply with IEEE C57.12.28 for galvanized steel.

2.2.2.2 Bus Bars

Bus bars shall be copper with silver-plated contact surfaces. Plating shall be a minimum of 0.0002 inch thick. Make bus connections and joints with hardened steel bolts. The through-bus shall be rated at the full ampacity of the main throughout the switchboard. Provide minimum one-quarter by 2 inch copper ground bus secured to each vertical section along the entire length of the switchboard. The neutral bus shall be rated 100 percent of the main bus continuous current rating as indicated.

2.2.2.3 Main Section

The main section shall consist of molded-case circuit breaker and utility transformer compartment.

2.2.2.4 Distribution Sections

The distribution sections shall consist of individually mounted, molded-case circuit breakers as indicated.

2.2.2.5 Auxiliary Sections/Compartments

Auxiliary sections shall consist of indicated metering equipment, and current transformer compartments as indicated.

2.2.2.6 Handles

Handles for individually mounted devices shall be of the same design and method of external operation. Label handles prominently to indicate device ampere rating, color coded for device type. Identify ON-OFF indication by handle position and by prominent marking.

2.2.3 Protective Device

2.2.3.1 Molded-Case Circuit Breaker

UL 489. UL listed and labeled, 100 percent rated, stationary,, manually operated, low voltage molded-case circuit breaker, with a short-circuit current rating of as indicated at 480 volts. Breaker frame size shall be as indicated. Series rated circuit breakers are unacceptable.

2.2.4 Electronic Trip Units

Equip main breakers as indicated with a solid-state tripping system consisting of three current sensors and a microprocessor-based trip unit that will provide true rms sensing adjustable time-current circuit protection. The ampere rating of the current sensors shall be the same as the breaker frame rating. The trip unit ampere rating shall be as indicated. The electronic trip units shall have the following features.

a. MainBreakers shall have long delay pick-up and time settings, and LED indication of cause of circuit breaker trip.

b. Main breakers shall have short delay pick-up and time settings.

d. Main Breakers shall have a digital display for phase and ground current.

e. Main Breakers shall have a digital display for watts, vars, VA, kWh, kvarh, and kVAh.

f. Main Breakers shall have a digital display for phase voltage, and percent THD voltage and current.

g. Main Breakers shall have provisions for communication via a network twisted pair cable for remote monitoring and control.

2.2.5 Watthour and Digital Meters

2.2.5.1 Digital Meters

Main breaker shall have Square D Power Logiv Series 4000 Circuit Monitor Model CM4250, with Model CMDVF display and Model ECC21 ethernet communications card. No substitutions will be allowed.

2.2.6 Current Transformers

IEEE C57.13. Transformers shall be single ratio, 60 hertz, 800 to 5-ampere ratio, 2.0 rating factor, with a metering accuracy class of 0.3 through B-0.5.

2.2.7 Meter Fusing

Provide a fuse block mounted in the metering compartment containing one fuse per phase to protect the voltage input to voltage sensing meters. Size fuses as recommended by the meter manufacturer.

2.2.8 Terminal Boards

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Terminal boards associated with current transformers

shall be short-circuiting type. Terminate conductors for current transformers with ring-tongue lugs. Terminal board identification shall be identical in similar units. External wiring shall be color coded consistently for similar terminal boards.

2.2.9 Wire Marking

Mark control and metering conductors at each end. Provide factory-installed, white, plastic tubing, heat stamped with black block type letters on factory-installed wiring. On field-installed wiring, provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Each sleeve shall contain a single letter or number, shall be elliptically shaped to securely grip the wire, and shall be keyed in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of individual sleeves. Each wire marker shall indicate the device or equipment, including specific terminal number to which the remote end of the wire is attached.

2.3 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable. This nameplate and method of attachment may be the manufacturer's standard if it contains the required information.

2.4 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each switchboard, equipment enclosure, relay, switch, and device; as specified in this section or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.5 SOURCE QUALITY CONTROL

2.5.1 Equipment Test Schedule

The Government reserves the right to witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

1. The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

3. Instrument calibration frequency schedule shall not exceed 12

months for both test floor instruments and leased specialty equipment.

4. Dated calibration labels shall be visible on all test equipment.

5. Calibrating standard shall be of higher accuracy than that of the instrument tested.

6. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

   (a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

   (b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.5.2 Switchboard Design Tests

NEMA PB 2 and UL 891.

2.5.2.1 Design Tests

Furnish documentation showing the results of design tests on a product of the same series and rating as that provided by this specification.

a. Short-circuit current test

b. Enclosure tests

c. Dielectric test

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Connect ground conductors to the upper end of the ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Equipment Grounding

Provide bare copper cable not smaller than No. 4/0 AWG not less than 24 inches below grade connecting to the indicated ground rods. When work in addition to that indicated or specified is directed to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect equipment furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Switchboard

NEMA PB 2.1.

3.3.2 Meters and Instrument Transformers

NEMA C12.1.

3.3.3 Field Applied Painting

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.3.4 Galvanizing Repair

Repair damage to galvanized coatings using ASTM A 780/A 780M, zinc rich paint, for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces that repair paint has been applied to.

3.3.5 Field Fabricated Nameplate Mounting

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

3.4.1 Exterior Location

Mount switchboard on concrete slab. Unless otherwise indicated, the slab shall be at least 4 inches thick. The top of the concrete slab shall be approximately 4 inches above grade. The slab shall be of adequate size to project at least 8 inches beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 3 inches above slab surface. Concrete work shall be as specified in Section 32 13 00 CAST-IN-PLACE CONCRETE FOR SITE WORK.

3.5 FIELD QUALITY CONTROL

Contractor shall submit request for settings of breakers to the Contracting Officer after approval of switchboard and at least 30 days in advance of

their requirement.

3.5.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.5.1.1 Switchboard Assemblies

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical, electrical, and mechanical condition.

3. Confirm correct application of manufacturer's recommended lubricants.

4. Verify appropriate anchorage, required area clearances, and correct alignment.

5. Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.

6. Verify that circuit breaker sizes and types correspond to approved shop drawings.

7. Verify that current transformer ratios correspond to approved shop drawings.

8. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

9. Confirm correct operation and sequencing of electrical and mechanical interlock systems.

10. Clean switchboard.

11. Inspect insulators for evidence of physical damage or contaminated surfaces.

12. Verify correct barrier installation.

13. Exercise all active components.

14. Inspect all mechanical indicating devices for correct operation.

15. Verify that vents are clear.

16. Test operation, alignment, and penetration of instrument transformer withdrawal disconnects.

17. Inspect control power transformers.

b. Electrical Tests

1. Perform insulation-resistance test on control wiring; Do not perform this test on wiring connected to solid-state components.

3.5.1.2 Circuit Breakers

Low Voltage Molded Case with Solid State Trips

a. Visual and Mechanical Inspection

1. Compare nameplate data with specifications and approved shop drawings.

2. Inspect circuit breaker for correct mounting.

3. Operate circuit breaker to ensure smooth operation.

4. Inspect case for cracks or other defects.

5. Inspect all bolted electrical connections for high resistance using low resistance ohmmeter, verifying tightness of accessible bolted connections and/or cable connections by calibrated torque-wrench method, or performing thermographic survey.

6. Inspect mechanism contacts and arc chutes in unsealed units.

b. Electrical Tests

1. Perform contact-resistance tests.

2. Perform insulation-resistance tests.

3. Perform Breaker adjustments for final settings in accordance with Government provided settings.

3.5.1.3 Current Transformers

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify correct connection.

4. Verify that adequate clearances exist between primary and secondary circuit.

5. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

6. Verify that all required grounding and shorting connections provide good contact.

3.5.1.4 Metering and Instrumentation

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify tightness of electrical connections.

b. Electrical Tests

1. Determine accuracy of meters at 25, 50, 75, and 100 percent of full scale.

2. Calibrate watthour meters according to manufacturer's published data.

3. Verify all instrument multipliers.

4. Electrically confirm that current transformer and voltage transformer secondary circuits are intact.

3.5.1.5 Grounding System

a. Visual and Mechanical Inspection

1. Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

1. IEEE Std 81. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

2. Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.5.2 Follow-Up Verification

Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. Circuit breakers shall be tripped by operation of each protective device. Test shall require each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract,

the Contracting Officer shall be given 5 working days advance notice of the dates and times for checks, settings, and tests.

-- End of Section --

SECTION 26 24 16.00 40

PANELBOARDS
11/08

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.

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 PB 1	(2006; Errata 2008) Standard for Panelboards

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	(Rev C) Colors Used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 67	(2009) Standard for Panelboards

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Detail Drawings for the panelboards consisting of fabrication and assembly drawings for all parts of the work in sufficient detail to enable the Government to check conformity with the requirements of the contract documents. Include within drawings details of bus layout.

Ensure Outline Drawings for panelboards indicate overall physical features, dimensions, ratings, service requirements, and weights of equipment.

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system or material meet specified requirements. Statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address.

1.3 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

Submit Detail Drawings; G and Outline Drawings; G for panelboards in accordance with paragraph entitled, "General Requirements," of this section.

SD-08 Manufacturer's Instructions

Submit Manufacturer's instructions for Panelboards;G including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

PART 2 PRODUCTS

2.1 PANELBOARDS

Totally enclose power-distribution panelboards and lighting and appliance branch-circuit panelboards in a steel cabinet, dead-front circuit breaker type with copper buses, surface- or flush-mounted as indicated. Ensure panelboards conform to NEMA PB 1 and NEMA AB 1. Branch circuit panels shall have buses fabricated for bolt-on type circuit breakers.

An outer door or cover, hinged on one side, shall be provided on surface-mounted panelboards to provide gutter space access. Provide a center door for circuit breaker/switch access only.

Voltage and current rating, number of phases, and number of wires shall be as indicated. Provide four-wire distribution panelboards and lighting and appliance branch-circuit panelboards with an isolated full-capacity neutral bus. Ensure panelboards are rated for 240-volt (maximum), single-phase 120/208-volt, three-phaseand 277/480-volt, three-phase, 60-hertz current.

Provide three-phase, 4-wire and single-phase, 3-wire distribution lighting and branch circuit panelboards with an isolated full-capacity bus providing spaces for single-pole circuit breakers/switches and spaces indicated as spare.

Provide panelboards with a separate grounding bus bonded to the enclosure. Grounding bus shall be a solid bus bar of rectangular cross section equipped with binding screws for the connection of equipment grounding conductors.

Each panelboard, as a complete unit, shall have a short-circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or as indicated.

Ensure panelboards and main lugs or main breaker have current ratings as shown on the panelboard schedule.

Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type. Three-phase, four-wire busing shall be such that when any three adjacent single-pole breakers are individually connected to each of the three different phases, two- or three-pole breakers can be installed at any location. Current-carrying parts of the bus assembly shall be plated. Mains ratings shall be as shown.

Mechanical lugs furnished with panelboards shall be cast copper or copper alloys of sizes suitable for the conductors indicated to be connected thereto.

Panelboard box shall be galvanized code-gage sheet steel without knockouts. Ensure entire panelboard front is hinged on one side with a piano hinge for the full height and has captive screws opposite the hinged side. Where panelboards are installed flush with the walls, the installation details shall be such that the hinged front can be opened without damage to the adjacent wall surfaces. Ensure that the color of the finished coat of trim and front matches the adjacent walls except when the box is installed in electrical closets or equipment rooms, the gray finish as specified is acceptable.

Panelboard enclosures shall be NEMA 250, Type 3R. Provide enclosures with hinged fronts and corrosion-resistant steel pin-tumbler cylinder locks. Key locks alike and provide two keys for each enclosure.

Finish panelboards with baked enamel. Finish color is to be No. 61 gray conforming to FED-STD-595.

2.2 CIRCUIT BREAKERS

Interrupting rating of circuit breakers shall be as indicated. If not shown, the interrupting rating for circuit breakers in 120/208 -volt panelboards shall be not less than 22,000 amperes rms symmetrical, and that for breakers in 277/480 -volt panelboards shall be not less than 22,000 amperes rms symmetrical.

Circuit breakers shall be bolt-on type. Plug-in type is not acceptable.

Provide shunt trips where indicated.

In branch circuit panelboards, branch circuit breakers feeding convenience outlets shall have sensitive instantaneous trip settings of not more than 10 times the trip rating of the breaker to prevent repeated arcing shorts resulting from frayed appliance cords. Single-pole 15- and 20-ampere circuit breakers shall be UL listed as "Switching Breakers" at 120 volts ac and 277 volts ac. This protection is an integral part of the branch circuit breaker that also provides overload and short-circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption is not to disturb the feeder circuit to the panelboard. A single-pole circuit breaker with integral ground fault circuit interruption requires no more panelboard branch circuit space than a conventional slide pole circuit breaker.

Ensure connections to the bus are bolt-on type.

When multiple wires per phase are specified, furnish the circuit breakers with connectors made to accommodate multiple wires.

Ensure circuit breaker spaces called out on the drawings are complete with mounting hardware to permit ready installation of the circuit breakers.

2.3 DIRECTORY CARD AND HOLDER

Mount a directory card on the inside of hinged fronts and doors 0.030-inch thick minimum plastic in a metal frame, with spaces for circuit numbers, outlets controlled, and room numbers. Directory card shall identify each

branch circuit with its respective and numbered circuit breaker.

2.4 FACTORY TESTING

Test complete panelboards in accordance with UL 67.

2.5 PRECAUTIONARY LABEL

To ensure persons are aware of immediate or potential hazard in the application, installation, use, or maintenance of panelboards, each panelboard shall be conspicuously marked on the trim or dead front shield with the text (or equivalent) **DANGER** symbol. If the panel is supplied with a door, ensure the label is visible when the door is in the open position.

PART 3 EXECUTION

3.1 INSTALLATION

Install panelboards as indicated and in accordance with the manufacturer's instructions. Fully align and mount panels so that the height of the top operating handle does not exceed 72-inches above the finished grade.

Directory-card information shall be typewritten in capital letters to indicate outlets controlled and final room numbers served by each circuit and shall be mounted in holders behind protective covering.

3.2 SITE TESTING

Each panelboard enclosure key shall be shown to operate the enclosure locks in the presence of the Contracting Officer.

Panelboards shall be given continuity and insulation tests after the installation has been completed and before the panelboard is energized.

Provide test equipment, labor, and personnel as required to perform the tests as specified. Conduct continuity tests using a dc device with bell or buzzer.

Conduct insulation tests on 480-volt panelboards using a 1,000-volt insulation-resistance test set. Record readings every minute until three equal and consecutive readings have been obtained. Resistance between phase conductors and between phase conductors and ground shall be not less than 50 megohms.

Conduct insulation tests on panelboards rated 300 volts or less using a 500-volt minimum insulation-resistance test set. Record readings after 1 minute and until the reading is constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Record test data and include the location and identification of panelboards and megohm readings versus time.

-- End of Section --

SECTION 26 33 53.00 20

UNINTERRUPTIBLE POWER SUPPLY (UPS)
04/08

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.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S1.4	(1983; Amendment 1985; R 2006) Specification for Sound Level Meters (ASA 47)

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE 450	(2010) Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications
IEEE C2	(2012; Errata 2012; INT 1 2012; INT 2 2012; INT 3 2012) National Electrical Safety Code
IEEE C57.110	(2008) Recommended Practice for Establishing Liquid-Filled and Dry-Type Power and Distribution Transformer Capability When Supplying Nonsinusoidal Load Currents
IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001	(2008; Corr 1 2009) Quality Management Systems- Requirements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA PE 1	(2003) Uninterruptible Power Systems (UPS) Specification and Performance Verification

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1449	(2006; Reprint Jul 2012) Surge Protective Devices
UL 1778	(2005; Reprint Oct 2011) Uninterruptible Power Systems

1.2 RELATED REQUIREMENTS

Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS, Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

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

UPS Drawings; G
UPS Installation; G

SD-03 Product Data

UPS Module; G

Submittal shall include manufacturer's information for each component, device, and accessory provided with the transformer.

Factory Testing
UPS System

UPS Spare Parts; G

SD-06 Test Reports

Performance Tests Report; G
Factory Tests Report; G

SD-09 Manufacturer's Field Reports

Initial Inspection and Tests; G
Performance Tests; G

SD-10 Operation and Maintenance Data

UPS Operation and Maintenance, Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

SD-11 Closeout Submittals

Installation

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Normal Operation

The UPS module rectifier/charger shall convert the incoming ac input power to dc power for the inverter and for float charging the battery. The inverter shall supply ac power to the critical load continuously. Inverter output shall be synchronized with the bypass ac power source, provided that the bypass ac power source is within the specified voltage and frequency range.

1.5.2 Emergency Operation (Loss or deviation of AC Input Power)

Whenever the ac input power source deviates from the specified tolerances or fails completely, the inverter shall draw its power from the battery system and shall supply AC power to the critical load without any interruption or switching. The battery shall continue to supply power to the inverter for the specified protection time or until return of ac input source. At the same time, an alarm shall sound to alert operating personnel and a trouble signal shall be sent over the communication network, allowing startup of a secondary power source or orderly shutdown of the critical load.

1.5.3 Return of AC Input Power Source

When stable ac input power source returns the rectifier/charger shall resume operation and shall simultaneously supply the inverter with dc power and recharge the battery. This shall be an automatic function and shall cause no disturbance to the critical load.

1.5.4 Failure of AC Input Power to Return

Should the ac input power fail to return before the battery voltage reaches the discharge limit, the UPS system shall disconnect from the critical load to safeguard the battery.

1.5.5 Transfer to Bypass AC Power Source

When the UPS controller senses an overload or degradation of the inverter output, the bypass switch shall automatically transfer the critical load from the inverter output to the bypass ac power source without an interruption of power. If the bypass ac power source is outside of specified tolerance limits, the UPS and the critical load shall shut down.

1.5.6 Retransfer to Inverter

The static bypass switch shall be capable of automatically retransferring the load back to the inverter output after the inverter output has returned to normal conditions. Retransfer shall only occur if the two sources are synchronized.

1.5.7 UPS Bypass Maintenance

Manual closure of the maintenance bypass switch shall transfer the critical load from the inverter output to the bypass ac power source without disturbing the critical load bus. UPS module shall be capable of manual return to normal operation after completion of maintenance.

1.5.8 Battery Maintenance

The battery protective device shall provide the means of disconnecting the battery from the rectifier/charger and inverter for maintenance. The UPS module shall continue to function and meet the performance criteria specified except for the battery back-up time function.

1.6 QUALITY ASSURANCE

The manufacturer shall have a documented quality assurance program including:

a. Inspections of incoming parts, modular assemblies and final product.

b. Final test procedure for the product including proof of performance specifications.

c. On-site test procedure shall include an inspection of controls and indicators after installation of the equipment.

d. ISO 9001 quality certification.

1.6.1 UPS Drawings

Detail drawings consisting of a complete list of equipment and materials, manufacturer's descriptive and technical literature, battery sizing calculations per IEEE 485, installation instructions, single-line diagrams, ladder-type schematic diagrams, elevations, layout drawings, and details required to demonstrate that the system has been coordinated and will function properly as a unit.

1.6.2 UPS Installation

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals

and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.3 Work Plan

Submit 6 copies of schedules of dates for factory tests, installation, field tests, and operator training for the UPS system. Furnish a list of instrumentation equipment for factory and field test reports.

1.6.4 Factory Test Plan

Submit 6 copies of factory test plans and procedures at least 21 calendar days prior to the tests being conducted. Provide detailed description of test procedures, including test equipment and setups, to be used to ensure the UPS meets the performance specification and explain the test methods to be used. As a minimum, the test procedures shall include the test required under the paragraph entitled "Factory Testing."

1.6.5 Performance Test Plan

Submit 6 copies of test plans and procedures at least 15 calendar days prior to the start of field tests. Provide detailed description and dates and times scheduled for performance of tests, and detailed description of test procedures, including test equipment (list make and model and provide functional description of the test instruments and accessories) and setups of the tests to be conducted to ensure the UPS meets the performance specification. Explain the test methods to be used. As a minimum, the test procedures shall include the tests required under the paragraph entitled "Performance Tests."

1.6.6 Factory Tests Report

Submit 6 copies of factory test report within 45 calendar days after completion of tests. Receive approval of test prior to shipping unit. Factory test reports shall be signed by an official authorized to certify on behalf of the UPS manufacturer of that the system meets specified requirements in accordance with the requirements set forth in paragraph entitled "Factory Testing". Test reports in shall be in booklet form tabulating factory tests and measurements performed, upon completion and testing of the installed system. Reports shall state the Contractor's name and address, the name of the project and location, and list the specific requirements which are being certified.

1.6.7 Performance Tests Report

Submit report of test results as specified by paragraph entitled "Performance Tests" within 15 calendar days after completion of tests. Field test reports shall be signed by an official authorized to certify on behalf of the UPS manufacturer that the system meets specified requirements in accordance with the requirements set forth in paragraph entitled "Performance Tests". Test reports in shall be in booklet form tabulating factory tests and measurements performed, upon completion and testing of the installed system. Reports shall state the Contractor's name and address, the name of the project and location, and list the specific requirements which are being certified.

1.6.8 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.

1.6.8.1 Reference Standard Compliance

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), American Society for Testing and Materials (ASTM), National Electrical Manufacturers 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.

1.6.8.2 Independent Testing Organization Certificate

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. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.6.9 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. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.6.9.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.9.2 Material and Equipment Manufacturing Date

Products manufactured more than 2 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 DELIVERY AND STORAGE

Equipment placed in storage shall be protected from humidity and temperature variations, moisture, water intrusion, dirt, dust, or other contaminants. In harsh environments where temperatures exceed non-operational parameters established within this specification, the equipment storage facility shall be environmentally controlled to ensure temperature parameters are within equipment specification. Documentation of same shall be provided to the Government when storage is implemented.

1.8 PROJECT/SITE CONDITIONS

1.8.1 Environmental Conditions

The UPS and battery system shall be capable of withstanding any combination of the following external environmental conditions without mechanical or electrical damage or degradation of operating characteristics.

a. Operating altitude: Sea level to 3,300 ft. (Systems applied at higher altitudes shall be derated in accordance with the manufacturer's instructions).

b. Non-operating altitude: Sea level to 36,000 ft.

c. Operating ambient temperature range: 32 to 104 degrees F. Range for batteries is 50 to 86 degrees F.

d. Non-operating and storage ambient temperature range: Minus 4 to plus 122 degrees F.

e. Operating relative humidity: 0 to 95 percent, without condensation.

1.8.2 Sound Pressure Levels

Sound pressure levels produced by the UPS, when operating under full rated load, at a distance of 5 feet in any direction from the perimeter of the unit, shall not exceed 75 dB as measured on the A scale of a Type 1 sound level meter at slow response conforming to ASA S1.4.

1.8.3 Verification of Dimensions

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.9 SPECIAL TOOLS

Provide one set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment.

1.10 OPERATION AND MAINTENANCE MANUALS

1.10.1 Additions to UPS Operation and Maintenance Manuals

In addition to requirements of Data Package 5, include the followings on the actual UPS system provided:

a. An outline drawing, front, top, and side views.

b. Prices for spare parts and supply list.

c. Routine and field acceptance test reports.

d. Date of Purchase.

e. Corrective maintenance procedures.

f. Test measurement levels with specific test points.

1.10.2 Spare Parts

Furnish the following spare parts, of the same material and workmanship, meeting the same requirements, and interchangeable with the corresponding original parts.

a. Fuses: Two of each type and rating.

b. Circuit boards: One circuit board for each critical circuit.

c. Air Filters: One set of filters.

1.11 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 UPS SYSTEM DESCRIPTION

The UPS system shall conform to UL 1778 and shall consist of UPS module, battery system, battery protective device, static bypass transfer switch, controls and monitoring. Input ac power shall be connected to the normal source ac input of the UPS module. The battery shall be connected to the dc input of the UPS module through the battery protective device. The ac output of the UPS system shall be connected to the critical loads.

2.1.1 Semiconductor Fusing

Power semiconductors shall be fused with fast-acting fuses to prevent cascaded or sequential semiconductor failures. Indicator lamp or display panel denoting blown fuse conditions shall be readily observable by the operator without removing panels or opening cabinet doors.

2.1.2 Control Power

Provide dual control power supplies. The control power circuit shall have suitable protection, appropriately marked and located in the immediate vicinity of the input protective device.

2.1.3 EMI/RFI Protection

The components and the system shall be designed to minimize the emission of electromagnetic waves that may cause interference with other equipment.

2.1.4 Internal Wiring

Wiring practices, materials, and coding shall be in accordance with the requirements of NFPA 70, OSHA, and other applicable standards. Wire runs shall be protected in a manner which separates power and control wiring. Control wiring shall be minimum No. 16 AWG extra-flexible stranded copper. Logic-circuit wiring may be smaller. Ribbon cables shall be minimum No. 22 AWG. Control wiring shall have permanently attached wire numbers.

2.1.5 Internal Assembly

The printed circuit board (PCB) subassemblies shall be mounted in pull-out and/or swing-out trays where feasible. Cable connections to the trays shall be sufficiently long to allow easy access to all components. Where not feasible to mount PCB subassemblies in pull-out or swing-out trays, they shall be firmly mounted inside the enclosure. Every PCB subassembly shall be monitored. Self-test and diagnostic circuitry shall be included in the logic circuits such that a fault can be isolated down to the PCB subassembly level.

2.1.6 Cabinets

UPS system shall be installed in cabinets of heavy-duty structure meeting the NEMA PE 1 standards for floor mounting. UPS module cabinet shall be structurally adequate for forklift handling or lifting. Removable lifting eyes shall be provided on top of each cabinet. UPS module cabinet shall have hinged and lockable doors on the front only, with assemblies and components accessible from the front. Doors shall be key lockable. Operating controls shall be located outside the locked doors. Input, output, and battery cables shall be installed through the top or bottom of the cabinet.

2.1.6.1 Cabinet Finish

Equipment cabinet shall be cleaned, primed and painted in the manufacturer's standard colors, in accordance with accepted industry standards. Cabinets shall be labeled in accordance with NFPA 70 for arc flash hazard with warning sign reading: "Warning-Potential Arc Flash Hazard. Appropriate PPE and Tools Required when working on this equipment" or similar wording.

2.1.6.2 Live Parts (300 Volts and Above)

Live parts (300 volts and above) that are exposed when front access doors are open shall be adequately protected or covered to minimize the chance of accidental contact.

2.1.6.3 Drawout Assemblies

Drawout assemblies weighing 50 lbsor more shall be provided with a means of lifting, either an overhead device or a hoisting device.

2.1.7 Safety

UPS shall be equipped with instruction plates including warnings and cautions, suitably located, and describing any special or important procedures to be followed in operating and servicing the equipment. The control panel display shall also provide warning messages prior to performing a critical function.

2.1.8 UPS System Load Profile

The UPS system shall be compatible with the load characteristics defined in the LOAD PROFILE below and load configuration. Compensation for UPS/load interaction problems resulting from nonlinear loads or transformer and motor inrush shall be provided.

LOAD PROFILE

Type of load: data processing equipment.

Size of load: 20, voltage,

Switching pattern: unswitched.

Steady-state characteristics: 0.9 lagging power factor.

2.2 UPS SYSTEM RATINGS

Unless stated otherwise, the parameters listed are under full output load at 0.8 power factor, with batteries fully charged and floating on the dc bus and with nominal input voltage.

2.2.1 System Capacity

30 kVA, 24 kW.

2.2.2 Battery Capacity

Discharge time to end voltage: 36 minutes, at 77 degrees F. End voltage at full discharge shall be 1.67 volts per cell. Battery shall be capable of delivering 150 percent of full rated UPS load at initial start-up.

2.2.3 Static Switch

22 amperes symmetrical interrupting capacity.

2.2.4 Module Bus Bracing

Braced for 22 amperes symmetrical interrupting capacity.

2.2.5 AC Input

a. Voltage 480 volts line-to-line.

b. Number of phases: 3-phase, 3 4-wire, plus ground.

c. Voltage Range: Plus 10 percent, minus 20 percent, without affecting battery float voltage or output voltage.

d. Frequency: 60 Hz, plus or minus 5 percent.

e. Power walk-in: 20 percent to 100 percent over 10 to 20 seconds.

f. Total harmonic current distortion (THD) reflected into the primary line: 5 percent maximum.

h. Input surge protection: per IEEE C62.41.1 and IEEE C62.41.2.

i. Input power factor: Lagging from 1-100 percent load.

2.2.6 AC Output

a. Voltage 208 volts line-to-line, 120 volts line-to-neutral.

b. Number of phases: 3-phase, 4-wire, plus ground.

c. Voltage regulation:

(1) Balanced load: Plus or minus 1.0 percent.

(2) 50 percent load imbalance, phase-to-phase: Plus or minus 2 percent.

(3) No-load voltage modulation: Plus or minus 1 percent.

(4) Voltage drift: Plus or minus 1 percent over any 30 day interval (or length of test) at stated ambient conditions.

d. Voltage adjustment: Plus or minus 5 percent manually.

e. Frequency: 60 Hz.

f. Frequency regulation: Plus or minus 0.1 percent.

g. Frequency drift: Plus or minus 0.1 percent over any 24 hour interval (or length of test) at stated ambient conditions when on internal oscillator.

h. Harmonic content (RMS voltage): Voltage THD shall be a maximum of 2 percent with 100 percent linear load and 5 percent with 100 percent nonlinear load and a crest factor of less than 3 to 1.

i. Load power factor operating range: 1.0 to 0.8 lagging.

j. Phase displacement:

(1) Balanced load: Plus or minus 1 degree of bypass input.

(2) 50 percent load imbalance phase-to-phase: Plus or minus 3 degrees of bypass input.

k. Wave-form deviation factor: 5 percent at no load.

l. Overload capability (at full voltage) (excluding battery):

(1) 125 percent load for 10 minutes.

(2) 150 percent load for 60 seconds.

(3) 300 percent load for one cycle after which it shall be current limited to 150 percent until fault is cleared or UPS goes to bypass.

2.2.7 Transient Response

2.2.7.1 Voltage Transients

a. 100 percent load step: Plus or minus 5 percent.

b. Loss or return of ac input: Plus or minus 1 percent.

c. Automatic transfer of load from UPS to bypass: Plus or minus 4 percent.

d. Manual retransfer of load from bypass to UPS: Plus or minus 4 percent.

e. Response time: Recovery to 99 percent steady-state condition within 20 milliseconds after any of the above transients.

2.2.7.2 Frequency

a. Transients: Plus or minus 0.6 Hz maximum.

b. Slew Rate: 1.0 Hz maximum per second.

2.2.8 Efficiency

Minimum Efficiency: 90 percent at full load kW and 90 percent at 50 percent load.

2.3 UPS MODULE

2.3.1 General Description

UPS module shall consist of a rectifier/charger unit and a 3-phase inverter unit with their associated transformers, synchronizing equipment, protective devices, surge suppression, input isolation transformer, and accessories as required for operation.

2.3.1.1 Interchangeability

The subassemblies in one UPS module shall be interchangeable with the corresponding modules within the same UPS, and from one UPS system to another of identical systems.

2.3.2 Rectifier/Charger Unit

Rectifier/charger unit shall be solid state and shall provide regulated direct current to the dc bus, supplying power to the inverter and charging the battery plant.

2.3.2.1 Input Protective Device

Rectifier/charger unit shall be provided with an input protective device. The protective device shall be sized to accept simultaneously the full-rated load and the battery recharge current. The protective device shall be capable of shunt tripping and shall have 22,000 amperes symmetrical interrupting rating. The protective device shall have provision for locking in the "off" position.

2.3.2.2 Surge Protection

A surge suppression device shall be installed at the UPS input to protect against lightning and switching surges. Internal components shall be protected from surges that enter at each ac input connection including main input, static bypass transfer switch. Surge suppressors shall protect internal components according to IEEE C62.41.1 and IEEE C62.41.2, Category B. Surge suppressors shall be UL 1449 approved to fail in "safe" mode.

2.3.2.3 Input Isolation Transformer

A dry-type, isolated-winding power transformer shall be used for the rectifier unit. The transformer's hottest spot winding temperature shall not exceed the temperature limit of the transformer insulation material when operating at full load. The transformer insulation shall be Class H, 150 degrees C rise. Transformer connections shall be accessible from the front. Transformer cabinet, if required, shall match the UPS cabinet and attach to it.

2.3.2.4 Power Walk-In

Rectifier/charger unit shall be protected by a power walk-in feature such that when ac power is returned to the ac input bus, the total initial power requirement will not exceed 20 percent of the rated full load current. This demand shall increase gradually to 100 percent of the rated full load current plus the battery charging current over the specified time interval.

2.3.2.5 Sizing

Rectifier/charger unit shall be sized for the following two simultaneous operating conditions:

a. Supplying the full rated load current to the inverter.

b. Recharging a fully-discharged battery to 95 percent of rated ampere-hour capacity within ten times the discharge time after normal ac power is restored.

2.3.2.6 Battery Charging Current

a. Primary current limiting: Battery-charging current shall be voltage regulated and current limited. The battery-charging current limit shall be separately adjustable from 2 percent to 25 percent of the maximum discharge current. After the battery is recharged, the rectifier/charger unit shall maintain the battery at full float charge until the next operation under input power failure. Battery charger shall be capable of providing equalizing charge to the battery.

2.3.2.7 DC Ripple

Rectifier/charger unit shall minimize ripple current and voltage supplied to the battery; the ripple current into the battery shall not exceed 3 percent RMS of the inverter input rated current; the ripple voltage into the battery shall not exceed 2 percent RMS of the float voltage.

2.3.2.8 DC Voltage Adjustment

Rectifier/charger unit shall have manual means for adjusting dc voltage for battery equalization, to provide voltage within plus 10 percent of nominal

float voltage.

2.3.2.9 Battery Isolation Protective Device

Module shall have a dc protective device to isolate the module from the battery system. The protective device size and interrupting rating shall be as required by system capacity and shall incorporate a shunt trip as required by circuit design. The protective device shall have provision for locking in the "off" position.

2.3.3 Inverter Unit

Inverter unit shall be a solid-state device deriving its power from the dc bus (rectifier or battery source) and providing ac power within specified limits to the critical load. Inverter shall utilize microprocessor controlled solid state Pulse Width Modulation (PWM) controlled IGBT power transistor technology to shape the ac output.

2.3.3.1 Output Overload

The inverter shall be able to sustain an overload as specified across its output terminals. The inverter shall not shut off, but shall continue to operate within rated parameters, with inverse-time overload shutdown protection. If the overload condition persists beyond the rated parameters of the inverter, the inverter shall current limit, load shall be transferred to the bypass source, and the inverter shall disconnect automatically from the critical load bus.

If the bypass source is not available and the overload/fault condition continues, the inverter shall current limit for a limited time as determined by the manufacturer and shall shut down to protect the internal components.

2.3.3.2 Output Frequency Control

The inverter shall normally operate in phase-lock and synchronism with the bypass source. When the bypass source frequency deviates by more than ±0.5 Hz, the internal frequency oscillator shall automatically take control and become the new frequency reference. Upon restoration of the bypass source within the required tolerance, the inverter shall synchronize back with that source at a slew rate not exceeding the specified rate. The oscillator shall be temperature compensated and shall be manually adjustable.

2.3.3.3 Output Protective Device

The output protective device shall be capable of shunt tripping or opening on an applied control signal and shall have the proper frame size and trip rating to supply overload current as specified. External output protective device shall have provision for locking in the "off" position. The inverter output protective device shall work in conjunction with the bypass protective device for both manual and automatic load transfers to and from bypass power.

2.3.3.4 Output Transformer

The inverter output transformer shall be similar to the input transformer and shall be capable of handling up to K-13 nonlinear loads as described in IEEE C57.110.

2.3.4 External Protection

UPS module shall have built-in self-protection against undervoltage, overvoltage, overcurrent and surges introduced on the ac input source and/or the bypass source. The UPS shall also have built-in self-protection against overvoltage and voltage surges introduced at the output terminals by paralleled sources, load switching, or circuit breaker operation in the critical load distribution system.

2.3.5 Internal Protection

UPS module shall be self-protected against overcurrent, sudden changes in output load and short circuits at the output terminals. UPS module shall be provided with output reverse power detection which shall cause the module to be disconnected from the critical load bus when output reverse power is present. UPS module shall have built-in protection against permanent damage to itself and the connected load for predictable types of failure within itself and the connected load. At the end of battery discharge limit, the module shall shut down without damage to internal components.

2.4 STATIC BYPASS TRANSFER CIRCUIT

A static bypass transfer circuit shall be provided as an integral part of the UPS and shall consist of a static switch, made up of two reverse-paralleled SCRs (silicon-controlled rectifiers) per phase conductor, and a bypass protective device or bypass switch, made up of a contactor or motor operated circuit breaker. The bypass protective device shall be in parallel with the static switch. The inverter output protective device shall disconnect and isolate the inverter from the bypass transfer circuit.

The control logic shall contain an automatic transfer circuit that senses the status of the inverter logic signals and alarm conditions and provides an uninterrupted transfer of the load to the bypass ac power source, without exceeding the transient limits specified herein, when a malfunction occurs in the UPS or when an external overload condition occurs. The power section of the static bypass transfer circuit shall be provided as a plug-in type assembly to facilitate maintenance. The static bypass transfer circuit shall be used to connect the input bypass ac power source to the critical load when required, and shall have the following features:

2.4.1 Uninterrupted Transfer

The static bypass transfer switch shall automatically cause the bypass ac power source to assume the critical load without interruption when the bypass control logic senses one of the following conditions and the UPS inverter output is synchronized to the bypass ac power source:

a. Inverter overload exceeds unit's rating.

b. Battery protection period is expired and bypass is available.

c. System failure.

d. Inverter output undervoltage or overvoltage.

2.4.2 Interrupted Transfer

If an overload occurs and the UPS inverter output is not synchronized to

the bypass ac power source, the UPS inverter output shall current-limit for 200 milliseconds minimum. The inverter shall then turn off and an interrupted transfer to the bypass ac power source shall be made.

If the bypass ac power source is beyond the conditions stated below, an interrupted transfer shall be made upon detection of a fault condition:

a. Bypass voltage greater than plus or minus 10 percent from the UPS rated output voltage.

b. Bypass frequency greater than plus or minus 0.5 Hz from the UPS rated output frequency.

c. Phase differential of ac bypass voltage to UPS output voltage greater than plus or minus 3 degrees.

2.4.3 Manual Transfer

It shall be possible to make a manually-initiated static transfer from the system status and control panel. The transfer shall be make-before-break utilizing the bypass switch.

2.4.4 Automatic Uninterrupted Forward Transfer

The static bypass transfer switch shall automatically forward transfer, without interruption after the UPS inverter is turned "on", or after an instantaneous overload-induced reverse transfer has occurred and the load current has returned to less than the unit's 100 percent rating.

2.4.5 Forced Transfer

The control logic circuitry shall provide the means of making a forced or reverse transfer of the static bypass transfer circuit on an interrupted basis. Minimum interruption shall be 200 milliseconds when the UPS inverter is not synchronized to the bypass ac power source.

2.4.6 Overload Ratings

The static bypass transfer switch shall withstand the following overload conditions:

a. 1000 percent of UPS output rating for one cycle.

b. 150 percent of UPS output rating for one minute.

c. 125 percent of UPS output rating for 10 minutes.

2.4.7 Static Switch Disconnect

A static switch disconnect shall be incorporated to isolate the static bypass transfer switch assembly so it can be removed for servicing. The switch shall be equipped with auxiliary contacts.

2.5 MODULE CONTROL PANEL

The UPS module shall be provided with a control/indicator display panel. The display panel shall be on the front of the UPS module. Controls, meters, alarms and indicators for operation of the UPS module shall be on this panel. The display panel shall be menu driven for browsing all the

screens.

2.5.1 Module Meters

2.5.1.1 Monitored Functions

The following functions shall be monitored and displayed:

a. Input voltage, phase-to-phase (all three phases).

b. Input current, all three phases.

c. Input frequency.

d. Battery voltage.

e. Battery current (charge/discharge).

f. Output voltage, phase-to-phase and phase-to-neutral (all three phases).

g. Output current, all three phases.

h. Output frequency.

i. Output kilowatts.

j. Elapsed time meter to indicate hours of operation, 6 digits.

k. Bypass voltage, phase-to-phase and phase-to-neutral (all three phases).

l. Output kilovars.

m. Output kilowatt hours, with 15-minute demand attachment.

n. Battery temperature.

o. Output Percentage load.

p. Remaining battery time.

2.5.1.2 Meter Construction

The display panel shall display alphanumeric parameters based on true RMS metering with 1 percent accuracy (minimum 4 significant digits).

2.5.2 Module Controls

Module shall have the following controls:

a. Lamp test/reset pushbutton.

b. Alarm test/reset pushbutton.

c. Module input protective device trip pushbutton, with guard.

d. Module output protective device trip pushbutton, with guard.

e. Battery protective device trip pushbutton, with guard.

f. Emergency off pushbutton, with guard.

g. DC voltage adjustment potentiometer, with locking guard.

h. Control power off switch.

i. UPS/bypass transfer selector switch.

j. Static bypass transfer switch enable/disable selector switch.

2.5.3 Module Alarm Indicators

Module shall have indicators for the following alarm items. Any one of these conditions shall turn on an audible alarm and the appropriate summary indicator. Each new alarm shall register without affecting any previous alarm.

a. Input ac power source failure.

b. Input protective device open.

c. Input power out of tolerance.

d. Overload.

e. Overload shutdown.

f. DC overvoltage/shutdown.

g. DC ground fault.

h. Low battery.

i. Battery discharged.

j. Battery protective device open.

k. Blower fan failure.

m. Low battery shutdown.

n. UPS on battery.

o. Equipment overtemperature.

p. Fuse blown (with indication where).

q. Control power failure.

r. Charger off/problem.

s. Inverter fault/off.

t. Emergency power off.

u. External shutdown (remote EPO activated).

v. Critical load on static bypass.

w. Static bypass transfer switch disabled/failure.

x. Inverter output overvoltage.

y. Inverter output undervoltage.

z. Inverter output overfrequency.

aa. Inverter output underfrequency.

bb. Bypass source voltage outside limits.

cc. Bypass frequency out of range.

dd. Bypass source to inverter out of synchronization.

ee. Overtemperature shutdown.

ff. Hardware shutdown.

2.5.4 Module Emergency OFF Button

Pressing the emergency off button shall cause the module to be disconnected from the system, via its input protective device, output protective device, and battery protective device. The button shall include a protective cover to prevent unintentional activation.

2.6 SELF-DIAGNOSTIC CIRCUITS

The control logic shall include status indicators for trouble-shooting the control circuits. These indicators shall be mounted on the circuit card edge or face such that they will be visible without repositioning the card, and shall be labeled with the function name.

2.7 REMOTE MONITORING PANEL

A remote monitoring panel shall be provided to monitor system status. The panel shall be designed for wall mounting near the critical load.

2.7.1 Indicators

Minimum display shall include the following indicators:

a. Load on UPS.

b. Load on battery.

c. Load on bypass.

d. Low battery.

e. Summary alarm.

f. New alarm (to alert the operator that a second summary alarm condition has occurred).

2.7.2 Audible Alarm

Any single indicator shall also turn on the audible alarm. An audible alarm

test/reset button and lamp test/reset button shall be included. This reset button shall not affect nor reset the alarm on the module.

2.8 COMMUNICATIONS AND DATA ACQUISITION

An RS 232 communications and data acquisition port shall be provided. This port shall allow the system parameters, status, alarm indication and control panel functions specified to be remotely monitored and controlled.

Additionally, a second communication port shall be provided for use with the following:

a. A set of six Form C remote alarm contacts rated at 120V, 0.5A, shall be provided for remote alarm monitoring.

b. Auto-dial modem communication shall be provided to communicate with a remote modem in case an alarm function is active.

c. A SNMP (Simple Network Management Protocol) adapter shall be provided to communicate UPS monitoring via a network or direct connection to a PC.

d. A standard Web Browser adapter shall be provided to remotely view and monitor UPS functions over the Internet.

e. Battery cell monitoring system to be remotely monitored.

All the communication ports and contacts shall be capable of simultaneous communication.

2.8.1 Emergency Control Contacts

Provide normally open contacts to signal when power is supplied to the UPS from emergency engine generators or alternate source.

2.9 TEMPERATURE CONTROL

2.9.1 General

Cabinet and enclosure ventilation shall be adequate to ensure that components are operated within their ratings. Forced-air cooled rectifier, inverter, and control unit will be acceptable. The cooling fans shall continue operation if UPS input power is lost. Redundancy shall be provided so that failure of one fan or associated circuit breaker will not cause an overheat condition. Cooling air shall enter the lower front of the cabinets and exhaust at the top. Blower power failure shall be indicated as a visual and audible alarm on the control panel. Air inlets shall have replaceable filters that may be located on the inside of the cabinet doors and shall be easily accessible for replacement.

2.9.2 Blower Power Source

Blower power source shall be internally derived from the output side of UPS module, with automatic transfer arrangement.

2.9.3 Temperature Sensors

Temperature sensors shall be provided to monitor the air temperature. Separate sensors shall monitor the temperature of rectifier and inverter heat sinks. Separate sensors shall also monitor the transformer temperature. Critical equipment over-temperature indication shall start a timer that shall shut down the UPS system if the temperature does not return below the setpoint level recommended by the UPS manufacturer.

2.10 BATTERY SYSTEM

2.10.1 General

Battery system shall contain the battery cells, racks, battery disconnect, battery monitor and cabinet, if required. A storage battery with sufficient ampere-hour rating to maintain UPS output at full capacity for the specified duration shall be provided for each UPS module. The battery shall be of heavy-duty, industrial design suitable for UPS service. The cells shall be provided with flame arrestor vents, intercell connectors and cables, cell-lifting straps, cell-numbering sets, and terminal grease. Intercell connectors shall be sized to maintain terminal voltage within voltage window limits when supplying full load under power failure conditions. Cell and connector hardware shall be stainless steel of a type capable of resisting corrosion from the electrolyte used.

2.10.2 Battery Ratings

a. Type: lead calcium.

b. Specific gravity when fully charged: 1.215.

c. End voltage 1.67 volts per cell.

d. Float voltage: 2.17 to 2.26 volts per cell.

e. Equalizing voltage: 2.33 to 2.38 volts per cell.

2.10.3 Battery Construction

The battery shall be of the valve-regulated, sealed, non-gassing, recombinant type.

2.10.4 Battery Cabinet

The battery pack assembly shall be furnished in a battery cabinet matching the UPS cabinet. The battery cabinet shall be designed to allow for checking the torque on the connections in the battery system and to provide adequate access for annual housekeeping chores. External wiring interface shall be through the bottom or top of the assembly. A smoke and high temperature alarm shall annunciate detection of either smoke or high temperature within the battery cabinet.

2.10.5 Battery Disconnect

Each battery pack assembly shall have a fused disconnect switch provided in a NEMA 1 enclosure, finished with acid-resistant paint and located in line with the assembly. Switch shall be complete with line side and load side bus bars for connection to battery cells. Switch shall be rated _____ V dc, 3-pole with interrupting rating as required by system capacity, and shall

have an external operator that is lockable in the "off" position.

2.10.6 Seismic Requirements

The battery support system shall conform to 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

2.10.7 Battery Monitor

A battery monitor system shall be provided for each battery cabinet assembly. At a minimum, this device shall monitor the following parameters:

a. Cell voltage, for each battery with data tracking and storage.

b. Ambient room temperature.

c. Total battery discharge cycles with a duration greater than a minute.

The monitor shall also record the total accumulated discharge minutes and accumulated battery system discharge kW hours. The monitor shall communicate with remote loacation through RS 232 port.

2.11 FACTORY TESTING

The UPS system shall be factory tested to meet the requirements specified using a test battery (not the battery to be supplied with the system). UPS module shall be factory load tested as an independent assembly with 3-phase ac input power and with battery power for a minimum of 8 hours, with meter readings taken every 30 minutes. Load shall be balanced at rated kVA and rated power factor. Factory tests for the UPS module shall be run under full load, and will be witnessed by the Government. Should a malfunction occur, the problem shall be corrected and the test shall be repeated. As a minimum, the factory tests shall include the parameters described in paragraphs ac Input, ac Output, Transient Response and Efficiency. The tests shall encompass all aspects of operation, such as module failure, static bypass operation, battery failure, input power failure and overload ratings. The Contracting Officer shall be notified in writing at least 2 weeks before testing. Factory-test time shall not be used for system debugging and/or checkout. Such work shall be done prior to notifying the Government that the system is ready for testing. Factory tests shall be performed during normal business hours. The system shall be interconnected and tested for an additional 8 hours to ensure proper wiring and performance.

2.11.1 Transient Tests

Transient tests shall be conducted using high-speed oscillograph type recorders to demonstrate the operation of the components to the satisfaction of the Government. These tests shall include 50 percent to 100 percent load changes, manual transfer, manual retransfer, low dc bus initiated transfer and low ac output bus transfer. A recording instrument equipped with an event marker shall be used.

2.11.2 Efficiency Tests

Testing for efficiency shall be performed at zero output up to 100 percent of stated kVA output in 25 percent steps, 0.8 power factor, with battery fully charged and floating on the dc bus, with nominal input voltage, and with module connected to represent actual operating conditions.

2.12 CABLE LUGS AND TERMINATIONS

2.12.1 Cable Lugs

Provide appropriate compression type lugs on all ac and dc power connections to the UPS system and battery as required. Aluminum or bare copper cable lugs are not suitable.

2.12.2 Terminations

Terminals shall be supplied for making power and control connections. Terminal blocks shall be provided for field wiring terminals. Terminal blocks shall be heavy-duty, strap-screw type. Terminal blocks for field wiring shall be located in one place in each module. Control wiring shall be extended to the terminal block location. No more than two wires shall land on any terminal point. Where control wiring is attached to the same point as power wiring, a separate terminal shall be provided. If bus duct is used, bus stubs shall be provided where bus duct enters cabinets.

2.13 INSPECTION

Inspection before shipment is required. The manufacturer shall notify the Government at least 2 weeks before shipping date so that an inspection can be made.

2.14 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 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 1.0 by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.15 MANUFACTURER'S NAMEPLATES

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.16 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.1.1 Control Cable

UPS control wiring shall be installed in individual separate rigid steel conduits, unless connections are made between side by side matching cabinets of UPS. Tag control wires with numeric identification tags corresponding to the terminal strip location to where the wires are connected. In addition to manufacturer's requirements, provide four additional spare conductors between UPS module and remote alarm panel in same conduit. When routing control cables inside UPS module, maintain a minimum 6 inches separation from power cables.

3.1.2 Grounding Conductor

Provide an insulated equipment grounding conductor in feeder and branch circuits. Conductor shall be separate from the electrical system neutral conductor. Ground battery racks and battery breaker cabinets with a separate equipment grounding conductor to the UPS cabinet.

3.1.3 UPS Output Conductors

Isolate the UPS output conductors from the UPS cabinet to the critical load panels and from other conductors by installing in separate conduit. Isolation shall prevent inductive coupling from other conductors.

3.1.4 DC Power Conductors

When installed in conduits, place dc power conductors from the UPS cabinet to the battery circuit breaker such that each conduit contains an equal number of positive and negative conductors, for example, two positive and two negative conductors in each conduit.

3.1.5 Seismic Protection

The UPS enclosure shall conform to 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

3.1.6 Conduit Entries

Conduit entries shall use the available conduit areas shown on manufacturer's installation drawings. Conduit entries shall not be made through the front, side or rear panels of the UPS or Maintenance Bypass Cabinet.

3.1.7 Battery Rack Assembly

Battery racks are typically shipped dismantled in separate rail, frame, and brace packages. Ensure that manufacturer furnished assembly hardware is used to assemble battery racks. Installation of battery racks shall conform to the manufacturer's instructions.

3.1.8 Battery Cabinet Assembly

Battery cabinets are typically factory assembled for up to 100 KVA UPS systems. Battery cabinets for larger units typically require assembly at the site. Installation of battery cabinets shall conform to the manufacturer's instructions.

3.1.9 Battery Installation

Installation of batteries shall conform to the manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

Contractor shall notify Contracting Officer in writing at least 45 calendar days prior to completion of the UPS system installation. At this time the Contractor, will schedule the UPS manufacturer's technical representative to inspect the completed installation. The UPS technical representative shall provide instruction for activity personnel as specified in paragraph titled "DEMONSTRATION".

3.2.1 Installation Preparation

The following items shall be completely installed by the Contractor and be operational prior to the arrival of the UPS representative for inspection, unit start-up and testing:

a. Ventilation equipment in the UPS and battery rooms.

b. Battery cabinets and cells. This is not applicable for maintenance-free battery.

c. Battery connections including cell-to-cell, tier-to-tier, and rack-to-rack connections, with correct polarity;

d. DC power and control connections between UPS and battery circuit breaker, with correct polarity;

e. DC power connection between battery circuit breaker and battery, with correct polarity;

f. Clockwise phase rotation of ac power connections;

g. AC power to rectifier input bus;

h. AC power to UPS bypass input bus;

i. AC power to UPS maintenance bypass circuit breaker;

j. AC power from UPS output to UPS maintenance bypass output circuit breaker;

k. Remote monitors and control wiring;

l. UPS system and battery system properly grounded;

m. Emergency shower and eye wash;

o. Control connections between UPS module and UPS maintenance bypass cabinet;

p. Clean and vacuum UPS and battery room floors, battery cells, and UPS equipment, both inside and outside.

p. Ensure that shipping members have been removed.

q. Provide IEEE 450 battery installation certification.

3.2.2 Initial Inspection and Tests

The UPS technical representative and the Contracting Officer, in the presence of the Contractor, will inspect the completed installation. The Contractor shall correct construction or installation deficiencies as directed. Perform acceptance checks in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections, performed in accordance with NETA ATS.

a. Visual and mechanical inspection

(1) Compare equipment nameplate data with drawings, specifications and approved shop drawings.

(2) Inspect physical and mechanical condition. Inspect doors, panels, and sections for paint, dents, scratches, fit, and missing hardware. Inspect the displays for scratches, dark pixels or uneven brightness.

(3) Inspect anchorage, alignment, grounding, and required clearances.

(4) Verify that fuse sizes and types correspond to drawings.

(5) Verify the unit is clean inside and out.

(6) Test all electrical and mechanical interlock systems for correct operation and sequencing.

(7) Inspect bolted electrical connections for high resistance using one of the following methods:

(a) Use a low-resistance ohmmeter.

(b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

(c) Perform thermographic survey.

(8) Verify operation of forced ventilation.

(9) Verify that vents are clear and new clean filters are installed.

3.2.3 Performance Tests

Provide equipment, test instruments, power, load bank, materials and labor required for tests. Contracting Officer will witness all tests and the tests shall be subject to his approval. Perform tests in accordance with the manufacturer's recommendations and include the following electrical tests.

3.2.3.1 UPS Unit Performance Tests

Upon completion of battery activation procedures, Contractor shall connect load bank to UPS output. Load bank required shall be determined by the following:

UPS KVA RATING X 0.8 = KW of LOAD BANK

Performance test is to be run under the supervision of the UPS technical representative. UPS unit shall be operated under full load for a minimum of one hour. Contractor shall be required to operate feeder and bypass power feeder breakers during testing of the UPS.

a. Electrical Tests

(1) Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

(2) Test static transfer from inverter to bypass and back. Use normal load, if possible.

(3) Set free running frequency of oscillator.

(4) Test dc undervoltage trip level on inverter input breaker. Set according to manufacturer's published data.

(5) Test alarm circuits.

(6) Verify synchronizing indicators for static switch and bypass switches.

(7) Perform electrical tests for UPS system breakers.

(8) Perform electrical tests for UPS system batteries.

b. Test Values

(1) Compare bolted connection resistances to values of similar connections.

(2) Verify bolt-torque levels.

(3) Micro-ohm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar connections by more than 50 percent of the lowest value.

c. Load Test

The installed system shall be load tested for a continuous 24 hour period by means of resistive load banks. The system shall be continuously tested at 1/2 load for 8 hours, 3/4 load for 8 hours and full load for 8 hours. Provide resistive load banks of total kW load of equipment to facilitate startup under load conditions, and to conduct load tests described above. Instrument readings shall be recorded every half hour for the following:

(1) Input voltage (all three phases).

(2) Input current (all three phases).

(3) Input frequency.

(4) Battery voltage.

(5) Output voltage (all three phases).

(6) Output current (all three phases).

(7) Output kilowatts.

(8) Output frequency.

e. Battery Discharge Test

With the battery fully charged, the system shall undergo a complete battery discharge test to full depletion and a recharge to nominal conditions. Instrument readings shall be recorded every minute during discharge for the following:

(1) Battery voltage.

(2) Battery current.

(3) Output voltage (all three phases).

(4) Output current (all three phases).

(5) Output kilowatts.

(6) Output frequency.

3.2.3.2 Emergency Generator Operation

Test UPS to observe operation with emergency generator service. UPS technical representative shall verify UPS battery current limiting feature functions properly.

3.2.3.3 Battery Performance Test (Constant KW)

Furnish all labor, material and test equipment necessary to conduct performance test under the direction of UPS technical representative. The following shall be accomplished:

a. Install a calibrated voltmeter across the battery terminals to measure voltage, and install a calibrated voltmeter across the UPS dc shunt to read charging current. UPS technical representative will advise connection to dc shunt.

b. Record temperature of pilot cells in battery immediately prior to start of discharge performance test.

c. Read and record total battery voltage and battery current at start of discharge and every minute during discharge test.

d. Record minutes and seconds when battery voltage drops below minimum discharge voltage of 291 volts dc. On initial discharge test, a battery may be expected to deliver 95 percent of its rated capacity. This will increase to 100 percent after several complete discharge cycles or after 12 months of float charge service.

e. Should battery fail to meet the requirements of the first discharge performance test, open the inverted output breaker. Then put battery on equalizing charge, with rectifier adjusted to normal equalizing voltage

of 424 volts dc. Equalize for a minimum of 100 hours. Measure and record time and battery voltage. Run a second discharge performance test.

3.3 DEMONSTRATION

3.3.1 Instructing Government Personnel

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. Provide 8 hours of instruction for 10 personnel. 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.

3.4 FINAL ADJUSTMENTS

a. Remove load bank and reconnect system for normal operation.

b. Equalize battery at 424 volts for a period of 72 hours.

d. Resume charging battery at normal float voltage of 411 volts dc.

e. Check battery connections are properly torqued to manufacturer's specifications. Take and record, for cell-to-cell and terminal connections, detailed micro-ohm resistance readings. Remake connections having a resistance of more than 10 percent above the average.

f. All manufacturer's data and operation manuals, which are an integral part of, and shipped with UPS, shall be delivered to Contracting Officer.

3.5 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.6 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.7 DISPOSAL

Upon completion of UPS installation and testing, Contractor shall remove

and dispose of empty, partially full and excess acid drums, including shipping containers, obsolete batteries, and obsolete UPS modules. Removal shall be accomplished off-base and in conformance with local laws and regulations regarding disposal of hazardous material.

-- End of Section --

SECTION 26 36 23.00 20

AUTOMATIC TRANSFER SWITCHES
04/06

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.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1008	(2012) Transfer Switch Equipment
UL 508	(1999; Reprint Apr 2010) Industrial Control Equipment

1.2 RELATED REQUIREMENTS

Section 01 86 26.07 40RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS. Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, and Section 26 08 00 APPARATUS INSPECTION AND TESTING, apply to this section, with the additions and modifications specified herein.

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

Automatic Transfer Switch Drawings; G

SD-03 Product Data

Automatic Transfer Switches; G

SD-06 Test Reports

Acceptance Checks and Tests; G
Functional Acceptance Tests; G

SD-07 Certificates

Proof of Listing; G

SD-10 Operation and Maintenance Data

Automatic Transfer Switches, Data Package 5; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Proof of Listing

Submit proof of listing by UL 1008.

1.4.2 Automatic Transfer Switch Drawings

Drawings shall include outline, arrangement, and detail drawings. Detail drawings shall include manufacturer's name and catalog number, electrical ratings, total system transfer statement, reduced normal supply voltage at which transfer to the alternate supply is initiated, transfer delay times, short-circuit current rating, wiring diagram, description of interconnections, testing instructions, acceptable conductor type for terminals, tightening torque for each wire connector, and other required UL 1008 markings.

PART 2 PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCHES

Provide four-pole, automatic transfer switches for use in emergency systems in accordance with UL 1008. Each automatic transfer switch shall be rated for total system transfer and have the current and voltage ratings as indicated. The rating of the switch shall be adequate for withstanding the effects of the indicated RMS symmetrical fault current when protected by the indicated overcurrent device without contact welding. The switch operating mechanism shall be electrically operated from the source to which it is transferring, shall have quick-make, quick-break, load break contacts, and shall be mechanically held in both positions. Switches utilizing circuit breakers are not acceptable. Non-fire pump service transfer switches shall have manual operating means provided for maintenance and servicing accessible only by opening the enclosure. The manual operating means shall affect the opening and closing of the switch contacts at the same rate of speed as that caused by the automatic operation of the switch. The switch enclosure shall comply with UL 508, NEMA Type 4 and shall be equipped with an equipment ground lug.

2.1.1 Automatic Transfer Switch Controls

2.1.1.1 Controls for Utility-Generator Automatic Transfer Switch

Provide all necessary controls to start the generator set upon loss of the normal (utility) source, transfer the load to the generator set upon reaching rated voltage and frequency, re-transfer the load when the normal (utility) source returns, and stop the generator set.

The switch shall include the following control features.

a. Three-phase normal source voltage sensing circuit with adjustable dropout, 75-93 percent of nominal, and pickup, 85-100 percent of nominal.

b. Engine starting control contacts with adjustable commit-to-start delay circuit, 0.5-6.0 seconds.

c. Voltage/frequency sensing circuit, set for 80 percent of nominal, for enabling load transfer to emergency source.

d. Transfer to emergency source time delay for transfer switches as indicated, adjustable 0-5 minutes.

e. Re-transfer to normal source time delay, adjustable 1-30 minutes.

f. Programmable exerciser to allow automatic starting of the generator set and subsequent load transfer. Exercise periods shall be selectable for 1 to 24 hours per day for 0 to 7 days a week.

g. Adjustable time delay transition or in-phase monitor feature for indicated transfer switches to allow safe transfer of highly inductive loads between two non-synchronized sources.

2.1.2 Front Panel Devices

Provide devices mounted on cabinet front consisting of:

a. Mode selector switch with the following positions and associated functions;

1. TEST - Simulates loss of normal/preferred source system operation.

2. NORMAL - Transfers system to normal/preferred source bypassing re-transfer time delay.

b. Lamps for indicating connected source and normal/preferred source is available.

c. Auxiliary contacts for indicating connected source and normal/preferred source available.

d. Source selector switch with the following positions and associated functions.

1. Source 1 - Selects Source 1 as the source to which the automatic transfer switch will transfer if that source is available.

2. Source 2 - Selects source 2 as the source to which the automatic transfer switch will transfer if that source is available.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall conform to the requirements of NFPA 70 and manufacturer's recommendation.

3.2 PREREQUISITES FOR FUNCTIONAL ACCEPTANCE TESTING

Completion of the following requirements is mandatory prior to scheduling functional acceptance tests for the automatic transfer switch.

3.2.1 Performance of Acceptance Checks and tests

Complete as specified in paragraph entitled "Acceptance Checks and Tests". The Acceptance Checks and Tests shall be accomplished by the Testing organization as described in Section 26 08 00 APPARATUS INSPECTION AND TESTING.

3.2.2 Manufacturers O&M Information

The manufacturers O&M information required by the paragraph entitled "SD-10 Operation and Maintenance Data", shall have been submitted to and approved by the Contracting Officer.

3.2.3 Test Equipment

All test equipment and instruments shall be on hand prior to scheduling field tests, or subject to Contracting Officer's approval, evidence shall be provided to show that arrangements have been made to have the necessary equipment and instruments on site prior to field testing.

3.3 FIELD QUALITY CONTROL

Give Contracting Officer 15 days notice of dates and times scheduled for tests which require the presence of the Contracting Officer. The Contracting Officer will coordinate with the using activity and schedule a time that will eliminate or minimize interruptions and interference with the activity operations. The contractor shall be responsible for costs associated with conducting tests outside of normal working hours and with incorporating special arrangements and procedures, including temporary power conditions. The contractor shall provide labor, equipment, apparatus, including test load, and consumables required for the specified tests. Calibration of all measuring devices and indicating devices shall be certified. The test load shall be a cataloged product in accordance with Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS. Perform the following field tests in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.3.1 Automatic Transfer Switch Acceptance Checks and Tests

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Confirm correct application of manufacturer's recommended lubricants.

4. Verify that manual transfer warnings are attached and visible.

5. Verify tightness of all control connections.

6. Verify tightness of accessible bolted connections by calibrated torque-wrench method. Thermographic survey is not required.

7. Perform manual transfer operation.

8. Verify positive mechanical interlocking between normal and alternate sources.

b. Electrical Tests

1. Measure contact-resistance.

2. Perform insulation-resistance on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole for one minute. Perform tests in both source positions.

3. Verify settings and operations of control devices.

4. Calibrate and set all relays and timers.

3.3.2 Functional Acceptance Tests

Functional Acceptance Tests shall include simulating power failure and demonstrating the following operations for each automatic transfer switch. Contractor shall show by demonstration in service that the automatic transfer switches are in good operating condition, and function not less than five times.

a. Perform automatic transfer tests:

1. Simulate loss of normal/preferred power.

2. Return to normal/preferred power.

3. Simulate loss of emergency power.

4. Simulate all forms of single-phase conditions.

b. Verify correct operation and timing of the following functions:

1. Normal source voltage-sensing relays.

2. Engine start sequence.

3. Time delay upon transfer.

4. Alternate source voltage-sensing relays.

5. Automatic transfer operation.

6. Interlocks and limit switch function.

7. Time delay and retransfer upon normal power restoration.

-- End of Section --

SECTION 31 23 00.00 20

EXCAVATION AND FILL
12/11

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 WATER WORKS ASSOCIATION(AWWA)

AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z535.1	(2006) Standard for Safety Color Code

ASTM INTERNATIONAL (ASTM)

ASTM C 136	(2005) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1140	(2000) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002e1) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2216	(2005) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2321	(2005) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2004) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2004) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4829	(2003) Expansion Index of Soils

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	Safety -- Safety and Health Requirements - Current Edition

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 530/F-93/004	(1993; Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes

1.2 DEFINITIONS

1.2.1 Capillary Water Barrier

A layer of clean, poorly graded crushed rock, stone, or natural sand or gravel having a high porosity which is placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below a slab.

1.2.2 Degree of Compaction

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557, for general soil types, abbreviated as percent laboratory maximum density.

1.2.3 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.4 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.5 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

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

Shoring and Sheeting Plan G

Dewatering work plan G

Submit 15 days prior to starting work.

SD-06 Test Reports

Borrow Site Testing; G

Fill and backfill test

Density tests

Moisture Content Tests

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Ground water will not be encountered along all utility and utility trench routes.

d. Hard materials and rock will be encountered.

e. Borrow material in the quantities required is available not on the project site.

f. Blasting will not be permitted. Remove material in an approved manner.

1.6 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCPL test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA 530/F-93/004 Method 5030/8020. TCLP shall be performed in accordance with EPA 530/F-93/004 Method 1311. Material shall not be brought on site until tests have been approved by the Contracting Officer.

1.7 QUALITY ASSURANCE

1.7.1 Shoring and Sheeting Plan

Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Drawings shall include material sizes and types, arrangement of members, and the sequence and method of installation and removal. Calculations shall include data and references used.

1.7.2 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.7.3 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

2.1.1 Satisfactory Materials

Any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity

index greater than zero.

2.1.4 Expansive Soils

Soils that have an expansion index (EI) equal to or greater than 20 when tested in accordance with ASTM D 4829.

2.1.5 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.6 Backfill and Fill Material

ASTM D 2487, classification GW, GP, GM, SW, SP, SM, with a maximum ASTM D 4318 liquid limit of 35, maximum ASTM D 4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D 1140, No. 200 sieve.

2.2 UTILITY BEDDING MATERIAL

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 1557 maximum density. Plastic piping shall have bedding to 12 inches above top of pipe. Provide ASTM D 2321 materials as follows:

a. Class I: Angular, 0.25 to 1.5 inches, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

2.2.1 Sand

Clean, coarse-grained sand classified as SW or SP by ASTM D 2487 for bedding and backfill as indicated.

2.2.2 Gravel

Clean, coarsely graded natural gravel, crushed stone or a combination thereof having a classification of GW or GP in accordance with ASTM D 2487 for bedding and backfill as indicated. Maximum particle size shall not exceed 3 inches.

2.3 BORROW

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property.

2.4 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic or 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, 6 inch minimum width, color coded as specified below

for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil and shall conform to ANSI Z535.1 with colors listed below as used by APWA and NEMA:

Warning Tape Color Codes

Red:	Electric Power and and Lighting Systems
Yellow:	Gas, Oil, Steam and Gaseous Materials
Orange:	Telephone, Fiber Optic, and Other Communications Systems
Blue:	Potable Water Systems
Purple:	Reclaimed Water Systems
Green:	Sanitary Sewer and Drain Systems
Gray:	Compressed Air

2.4.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.4.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.5 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Shoring and Sheeting

Provide shoring, bracing, sheeting where indicated. In addition to Section 25 A and B of EM 385-1-1 and other requirements set forth in this contract, include provisions in the shoring and sheeting plan that will accomplish the following:

a. Prevent undermining of pavements, foundations and slabs.

b. Prevent slippage or movement in banks or slopes adjacent to the excavation.

c. Allow for the abandonment of shoring and sheeting materials in

place in critical areas as the work is completed. In these areas, backfill the excavation to the elevation indicated and remove the remaining exposed portion of the shoring before completing the backfill.

3.1.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.1.2.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction. Grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, dikes, swales, and other drainage features and equipment as required to maintain dry soils, prevent erosion and undermining of foundations. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.1.2.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 3 feet below the working level.

3.1.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall scan the construction site with electromagnetic and sonic equipment and mark the surface of the ground where existing underground utilities are discovered.

3.1.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been

displaced or damaged.

3.2 SURFACE PREPARATION

3.2.1 Clearing and Grubbing

Unless indicated otherwise, remove trees, stumps, logs, shrubs, brush and vegetation and other items that would interfere with construction operations within the indicated project limits. Remove stumps entirely. Grub out matted roots and roots over 2 inches in diameter to at least 18 inches below existing surface.

3.2.2 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with backfill and fill material and compact to 95 percent of ASTM D 1557 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with backfill and fill material and compact to 95 percent of ASTM D 1557 maximum density. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.3.1 Structures With Spread Footings

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Fill over excavations with concrete during foundation placement.

3.3.2 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length.

3.3.3 Excavated Materials

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF

SURPLUS MATERIAL."

3.4 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified herein.

3.5 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.5.1 Common Fill Placement

Provide for general site. Place in 6 inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.5.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in 6 inch lifts. Do not place over wet or frozen areas. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.5.3 Backfill and Fill Material Placement Over Pipes and at Walls

Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be

placed carefully around pipes to avoid damage to coatings or wrappings. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

3.5.4 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 6 inch lifts to top of trench and in 6 inch lifts to one foot over pipe outside structures and paved areas.

3.6 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved borrow materials shall be obtained as specified herein.

3.7 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.8 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.9 COMPACTION

Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required. Density requirements specified herein are for cohesionless materials. When cohesive materials are encountered or used, density requirements may be reduced by 5 percent.

3.9.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5 foot line of the paved area or structure to 85 percent of ASTM D 1557. Compact expansive materials to not less than 85 percent nor more than 90 percent.

3.9.2 Structures, Spread Footings, and Concrete Slabs

Compact top 12 inches of subgrades to 95 percent of ASTM D 1557. Compact fill and backfill material to 95 percent of ASTM D 1557.

3.9.3 Adjacent Area

Compact areas within 5 feet of structures to 90 percent of ASTM D 1557.

3.9.4 Paved Areas or Buried Structures

Compact top 12 inches of subgrades to 95 percent of ASTM D 1557. Compact fill and backfill materials to 95 percent of ASTM D 1557.

3.10 FINISH OPERATIONS

3.10.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.11 DISPOSITION OF SURPLUS MATERIAL

Remove from Government property surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber.

3.12 FIELD QUALITY CONTROL

3.12.1 Sampling

Take the number and size of samples required to perform the following tests.

3.12.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.12.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 4318 for liquid limit and for plastic limit; ASTM D 1557 for moisture density relations, as applicable.

3.12.2.2 Density Tests

Test density in accordance with ASTM D 1556, or ASTM D 2922 and ASTM D 3017. When ASTM D 2922 and ASTM D 3017 density tests are used, verify density test results by performing an ASTM D 1556 density test at a location already ASTM D 2922 and ASTM D 3017 tested as specified herein. Perform an ASTM D 1556 density test at the start of the job, and for every 10 ASTM D 2922 and ASTM D 3017 density tests thereafter. Test each lift at randomly selected locations every 2000 square feet of existing grade in fills for structures and concrete slabs, and every 2500 square feet for other fill areas and every 2000 square feet of subgrade in cut. Include density test results in daily report.

a. Bedding and backfill in trenches: One test per 50 linear feet in each lift.

3.12.2.3 Moisture Content Tests

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required

during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D 2216. Include moisture content test results in daily report.

-- End of Section --

SECTION 32 10 00

BITUMINOUS CONCRETE PAVEMENT
08/08

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 T 102	(1983; R 2000) Spot Test of Asphaltic Materials
AASHTO T 230	(1968; R 2000) Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures
AASHTO T 30	(1993; R 1998) Mechanical Analysis of Extracted Aggregate

ASTM INTERNATIONAL (ASTM)

ASTM D 977	(2003) Emulsified Asphalt
ASTM D 1557	(2002e1) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 1559	(1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2172	(2001e1) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2950	(1991; R 1997) Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D 4280	(2004) Extended Life Type, Nonplowable, Raised, Retroreflective Pavement Markers

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-P-1952	(Rev D) Paint, Traffic and Airfield Markings, Waterborne
FS TT-B-1325	(Rev C) Beads (Glass Spheres) Retro-Reflective (Metric)

U.S. DEPARTMENT OF COMMERCE (DOC)

PS20 (1999) American Softwood Lumber Standard

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CDT)

SS-1 (2006 Edition) Standard Specifications

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. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-05 Design Data

Job mix design for asphalt concrete; G

Asphalt concrete; G

Asphalt cement; G

Aggregates; G

Liquid asphalt; G

Asphaltic emulsion; G

Paint; G

Reflective media (glass beads); G

Traffic signs; G

SD-06 Test Reports

Asphalt concrete

Submit reports for testing specified under paragraph entitled "Field Quality Control."

SD-07 Certificates

Asphalt mix delivery record

Asphalt concrete and material sources

Obtain approval of the Contracting Officer for materials and material sources 2 days prior to the use of such material in the work.

Asphalt concrete

Traffic signs

Submit certificates, signed by the producer, that paving materials and incidental construction items conform to specification requirements.

1.3 QUALITY ASSURANCE

1.3.1 Regulatory Requirements

Provide work and materials in accordance with applicable requirements of SS-1. Sections and Paragraphs mentioned herein refer to those specifications.

1.3.2 Modification of References

Where term "Engineer" is used in SS-1 it shall be construed to mean Contracting Officer. Where term "state" is used, it shall mean "Federal Government".

1.3.3 Mix Delivery Record Data

Record and submit the following information to each load of mix delivered to the job site. Submit within one day after delivery on Government-furnished forms:

a. Truck No:

b. Time In:

c. Time Out:

d. Tonnage and Discharge Temperature:

e. Mix Type:

f. Location:

g. Stations Placed:

1.3.4 Mix Design

Submit results of laboratory tests performed on each mix design. Testing shall have been accomplished not more than one year prior to date of material placement.

1.4 ENVIRONMENTAL CONDITIONS

Apply paint to clean, dry surfaces and unless otherwise approved, only when air and pavement temperatures are above 40 degrees F for oil-based materials, 50 degrees F for water-based materials, and are less than 95 degrees F. Maintain paint temperature within the same limits.

1.5 EQUIPMENT

1.5.1 Mixing Plant and Construction Equipment

Section 39 of SS-1. Machines, tools, and equipment used in the performance of the work shall be approved by the Contracting Officer and maintained in satisfactory operating condition.

1.5.2 Painting Equipment

Use a stripe painting machine-capable of producing marking and striping as

indicated. Provide equipment having a compressor output capacity of at least 105 cubic feet per minute (cfm) and capable of operating at an air pressure of not less than 125 psi. Provide striping machine with a pointer so the machine will hold exactly to alignment. Provide propelling vehicle with a speedometer or tachometer, and with a suitable device for determining quantity of paint in the container. Mechanically agitate paint while equipment is in operation. Clean paint container and spray nozzles on machine before starting work each day.

1.5.2.1 Reflective Media (Glass Bead) Dispenser

The dispenser for applying reflective media shall be attached to the paint dispenser and shall operate automatically and simultaneously with the applicator through the same mechanism. The dispenser shall be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the strip at the rate of coverage specified in the paragraph, APPLICATION, at all operating speeds of the applicator to which it is attached.

PART 2 PRODUCTS

2.1 ASPHALT CONCRETE

Provide asphalt concrete in accordance with the applicable requirements of SS-1, Section 39, Type B for individual test results conforming to 1/2 inch maximum size gradation, medium.

2.2 BASE COURSE AGGREGATES

Imported base course: Section 26 of SS-1, Class 2, for 3/4 inch maximum size gradation.

2.3 ASPHALT MATERIALS

2.3.1 Asphalt Cement

Section 92 of SS-1, Asphalt Binder (Performance Grade) PG 70-10.

2.3.2 Liquid Asphalt (Prime Coat or)

Section 93 of SS-1, Grade SC-250.

2.3.3 Asphaltic Emulsion (Tack Coat or Fog Seal)

Section 94 of SS-1, Grade SS-1 or ASTM D 977, Type SS-1. Asphaltic emulsion shall be diluted with equal parts of water. The base asphalt used to manufacture the emulsion shall show a negative spot test when tested in accordance with AASHTO T 102 using standard naphtha.

2.4 STRIPING

SS-1, Section 84-3.

Paint shall conform to FS TT-P-1952, Fast Dry or Rapid Dry type. Color shall be yellow, white, or red as indicated or directed by the Contracting Officer.

2.4.1 Reflective Media

Reflective media for streets and roads shall conform to FS TT-B-1325, Type I, Gradation A.

2.4.2 Pavement Markers

Reflective pavement markers shall be of the prismatic reflector type conforming to Section 85-1 of SS-1, color as indicated. Pavement markers to designate lane changes or adjustments shall be white or as directed by the Contracting Officer. Pavement markers that designate fire hydrant locations shall be blue and shall be located along the roadway centerline (2 feet off of the centerline in the direction of the fire hydrant). Markers shall be of permanent colors as specified and shall retain their color and brightness under the action of traffic. Markers shall not project more than 3/4 inch above the level of pavement. Pavement markers shall be applied to the new pavement at the locations indicated using epoxy adhesive conforming to Section 95 of SS-1 or ASTM D 4280.

2.5 CURBS AND MISCELLANEOUS AREAS

SS-1, Section 39-7. Headerboard materials for construction of curbs and miscellaneous areas shall be made of 2 X 4 inch lumber secured in place using 2 X 4 x 24 inch minimum length stakes located not more than 6 feet apart. Use either redwood rough sawn, construction, or clear heart grade), western red cedar, or pressure-treated Douglas fir conforming to PS20.

2.6 TRAFFIC SIGNS

SS-1, Section 56-2, size, type, and wording as indicated.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Excavation and Filling

Excavation and filling to establish elevation of subgrade is specified in Section 31 23 00.00 20 EXCAVATION AND FILL.

3.2 CONSTRUCTION

Provide construction in accordance with the applicable requirements of the Section 31 23 00.00 20 EXCAVATION AND FILL.

3.2.1 Subgrade

Requirements for Subgrade are specified in Section 31 23 00.00 20 EXCAVATION AND FILL, except where indicated or specified otherwise. Prior to construction of base course, clean previously constructed subgrade of foreign substances.

3.2.2 Base Course

Place aggregate base course on prepared subgrade in accordance with the requirements of Section 39 of SS-1. Grade and compact in layers to at least 95 percent of maximum density, ASTM D 1557, Method D. Maintain base course in proper condition until asphalt concrete is in place, including drainage, rolling, shaping and watering. Maintain sufficient moisture at

the surface to prevent a dusty condition by light sprinkling with water. Recondition, reshape, and recompact areas of completed base course damaged by wet weather in accordance with the specified requirements.

3.2.3 Prime Coat

Prior to application of asphalt concrete, apply a prime coat of asphalt binder. Apply by pressure distributors. Allow sufficient time before placing asphalt concrete to permit prime coat to penetrate base.

3.2.3.1 Liquid Asphalt Application

Apply liquid asphalt on prepared compacted base at a rate of 0.25 gallons per square yard in accordance with Section 39 of SS-1.

3.2.3.2 Paint Binder

Apply paint binder (asphalt emulsion) to existing pavement surfaces in accordance with Section 39 of SS-1. Unless otherwise directed, apply at a rate of 0.05 gallon per square yard to the exposed edges of existing pavement against which new asphalt concrete pavement is indicated to be placed.

3.2.4 Surface Course

Uniformly mix mineral aggregate with bituminous material in a central plant in accordance with Section 39 of SS-1. The percentage of asphalt cement binder shall be between five and seven percent. Type B asphalt concrete shall be placed only when the atmospheric temperature is 50 degrees F and rising. Deliver bituminous mixtures to the previously prepared base course surface in accordance with Section 39 of SS-1. Spread in accordance with Section 39 of SS-1. Placement will not be permitted unless the Contractor has a working asphalt thermometer on site. The paving asphalt shall be delivered at a temperature of not less than 285 degrees F or more than 350 degrees F. Asphalt concrete shall be placed in maximum layers to achieve the finished pavement thickness shown, with no single layer exceeding a compacted thickness of 3 inches.

3.2.4.1 Compaction

Perform initial or breakdown rolling by making one pass over asphalt pavement with a two-axle or three-axle tandem steel wheel roller or a three wheel steel roller with rollers weighing at least 12 tons. Initial or breakdown rolling shall be performed when the temperature of the asphalt concrete is not less than 250 degrees F. Commence rolling at the lower edge and progress toward the highest portion. Under no circumstances shall the center be rolled first. Perform rolling with the drive wheel of the tandem roller forward with respect to the direction of spreading operations. Follow the initial or breakdown rolling with three complete passes of a pneumatic-tired roller while the temperature of the mixture is at least 200 degrees F. Perform final rolling of the uppermost layer of asphalt concrete using an 8-ton two-axle tandem roller in a manner that will avoid cracking, shoving or displacement.

3.2.4.2 Joining Pavement

Carefully make joints between old and new pavement and of successive day's work in such manner as to ensure a continuous bond between old and new sections of the course. Expose and clean edges of existing pavement. Cut

edges to straight, vertical surfaces. Paint joints with a uniform coat of paint binder before the fresh mixture is placed. Prepare joints in the new pavement in accordance with Section 39 of SS-1.

3.2.4.3 Miscellaneous Areas

Surfacing of areas outside of the traveled way shall be designated miscellaneous areas and shall be paved with asphalt concrete in accordance with Section 39-7 of SS-1.

3.2.5 Striping

3.2.5.1 Application

SS-1, Section 84-3, use type of paint specified. Apply one coat of paint at a maximum rate of 110 square feet per gallon of paint. Apply paint to required width, with clean true edges and without sharp breaks. Allow bituminous pavement to cure for at least 30 days before paint and reflective media are applied. Pavement shall be thoroughly clean and entirely free of loose sand, stones, dust, oil, grease, water, and other substances that will be deleterious to the paint or will adversely affect the adhesion of the paint. Clean pavement surfaces immediately prior to painting with power broom followed by a power blower using compressed air. Do not apply paint during high wind (over 15 miles per hour) or high humidity (over 70 percent). Apply paint only when ambient temperature is 40 degrees F or above and rising but not more than 95 degrees F. Edges of markings shall be sharply outlined with dimensions and arrangement of markings as indicated.

3.2.5.2 Paint And Reflective Media

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Apply paint to a wet film thickness of 0.015 inch by means of approved conventional pneumatic traffic line striping equipment. The Contractor shall provide guide lines and templates to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Traffic shall not be permitted to use the painted areas for a minimum of 6 hours after painting of lines has been completed. Repaint existing markings damaged by construction. Individual raised pavement markers shall be located as indicated.

3.2.5.3 Rates Of Application

Pigmented binder (i.e., paint) shall be applied evenly to the pavement area at a rate of 110 plus/minus 5 square feet per gallon. Glass spheres (reflective media) shall be applied uniformly to the wet paint on the pavement at a rate of 6 plus/minus 0.5 pounds of glass spheres per gallon of paint.

3.2.6 Traffic Signs

SS-1, Section 56.

3.3 FIELD QUALITY CONTROL

Sample shall be taken by Contractor as specified herein. Contractor shall replace pavement where sample cores have been removed. Submit 2 pavement cores when using the in-place nuclear density method.

3.3.1 Sample and Core Identification

Place each sample and core in a container and securely seal to prevent loss of material. Tag each sample for identification. Tag shall contain the following information:

a. Contract No.

b. Sample No.

c. Quantity

d. Date of Sample

e. Sample Description

f. Source/Location/Stations Placed/depth below the finish grade

g. Intended Use

h. Thicknesses of various lifts placed

3.3.2 Testing

3.3.2.1 Bituminous Mix Testing

Take two samples per day per mix type at plant or from truck. Test uncompacted mix for extraction in accordance with ASTM D 2172 and sieve analysis in accordance with AASHTO T 30. Test samples for stability and flow in accordance with ASTM D 1559. When two consecutive tests fail to meet requirements of specifications, cease placement operations and test a new trial batch prior to resumption of placement operations. Submit 2 per day of each mix type. When two tests on uncompacted mix fail submit new trial batch for approval.

3.3.2.2 Testing of Pavement Course

a. Density: Determine density of pavement by testing cores obtained from the binder and wearing course in accordance with AASHTO T 230. Take three cores at location designated by Contracting Officer for each 100 tons, or fraction thereof, of asphalt placed. Deliver cores undisturbed and undamaged to laboratory and provide test results within 48 hours of each day placement of paving materials.

b. Thickness: Determine thickness of the pavement course from cores taken for density test.

c. Straightedge Test: Test compacted surface of binder course and wearing course with a straightedge as work progresses. Apply straightedge parallel with, and at right angles to, the center line of each travel lane after final rolling. Variations in the pavement course surface shall not be more than 1/4 inches from the lower edge of the 10 foot straightedge. Pavement showing irregularities greater than that specified shall be corrected as directed by Contracting Officer.

3.3.2.3 Alternate Testing Method for Pavement Courses

At Contractor's option the following in-place testing method may be used to determine density and thickness in lieu of testing specified above. Frequency of testing shall be the same. When in-place nuclear method to determine density is used, take two pavement cores at locations designated by Contracting Officer and turn over to Government to verify pavement thickness.

a. Density: Determine density of pavement by in-place testing using Nuclear Method in accordance with ASTM D 2950.

b. Thickness: Determine thickness of finished pavement by use of following equation:

$$t = \frac{W}{0.75d}$$

Where t= pavement thickness, in inches.
W= average weight per square yard of mixture actually used in work.
d= compacted density as measured by nuclear density device.

-- End of Section --

SECTION 32 13 00

CAST-IN-PLACE CONCRETE FOR SITE WORK
11/11

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	(2007) Manual of Concrete Practice Part 1: ACI 104-71R-97 to 223-98
ACI/MCP-2	(2007) Manual of Concrete Practice Part 2 - ACI 224R-01 to ACI 313R-97
ACI/MCP-3	(2007) Manual of Concrete Practice Part 3 - ACI 315-99 to ACI 343R-95
ACI/MCP-4	(2006) Manual of Concrete Practice Part 4 - ACI 345R-05 to 355.2R-04

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(2005) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats
AASHTO M 53	(1996) Standard Specification Axle-Steel Deformed and Plain Bars for Concrete Reinforcement

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(2004) Basic Hardboard

AMERICAN WELDING SOCIETY (AWS)

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

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	(2008a7) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	(2008) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 780	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
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 1017/C 1017M	(2007) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1107/C 1107M	(2007a) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C 143/C 143M	(2008) 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 1567	(2007) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 172	(2007) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 174/C 174M	(2006) Standard Test Method for Measuring Length of Drilled Concrete Cores
ASTM C 192/C 192M	(2007) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

ASTM C 231	(2008b) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 233	(2007) Standard Test Method for Air-Entraining Admixtures for Concrete
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 295	(2003) Petrographic Examination of Aggregates for Concrete
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2008) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 311	(2008a) 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	(2005e1) 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 595	(2008) Standard Specification for Blended Hydraulic Cements
ASTM C 618	(2008) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 78	(2002) Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Pont Loading)
ASTM C 881/C 881M	(2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 932	(2006) Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering
ASTM C 94/C 94M	(2007) Standard Specification for

	Ready-Mixed Concrete
ASTM C 989	(2006) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM D 1557	(2002e1) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2,700 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 1752	(2004a) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 5759	(1995; R 2005) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM D 7116	(2005) Standard Specification for Joint Sealants, Hot Applied, Jet Fuel Resistant Types, for Portland Cement Concrete
ASTM E 329	(2007) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM E 648	(2006a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI MSP-2	(1998) Manual of Standard Practice

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001	(2000) Principles and Criteria for Forest Stewardship

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(1996) Construction and Industrial Plywood

U.S. DEPARTMENT OF COMMERCE (DOC)

PS1	(1995) Construction and Industrial Plywood (APA V995)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

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

FS SS-S-200	(Rev E; Am 2) Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 DEFINITIONS

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

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

d. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the 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

Formwork

Reinforcing steel; G

Reproductions of contract drawings are unacceptable.

Provide erection drawings for concrete Formwork that show placement of reinforcement and accessories, with reference to the contract drawings.

SD-03 Product Data

Materials for curing concrete; G

Joint sealants; (LEED) G

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, and waterstops.

Joint filler; (LEED); G

Reinforcement; G

Cement; (LEED); G

Recycled Aggregate Materials; G

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

Epoxy bonding compound; G

Bonding materials; G

Ready-Mix Concrete; G

Curing Concrete Elements; G

Local/Regional Materials; (LEED); G

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Biodegradable Form Release Agent

Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

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. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used

when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes. Submit copies of the fly ash and pozzolan test results, in addition. The approval of fly ash and pozzolan test results must be within 6 months of submittal date. Obtain acknowledgement of receipt prior to concrete placement.

SD-06 Test Reports

Concrete mix design; G

Fly ash

Pozzolan

Ground granulated blast-furnace slag

Aggregates

Compressive strength tests

Flexural Concrete Tests

Air content

Slump

Pavement Thickness

Curing Concrete Elements

SD-07 Certificates

Pumping concrete

Biodegradable Form Release Agent

VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Material Safety Data Sheets

Forest Stewardship Council (FSC) Certification

SD-08 Manufacturer's Instructions

Fly ash

Ground granulated blast-furnace slag

Submit mill certificates for Steel Bar according to the paragraph entitled, "Fabrication," of this section.

Provide certificates for concrete that are in accordance with the paragraph entitled, "Classification and Quality of Concrete," of this section. Provide certificates that contain project name and number, date, name of Contractor, name of concrete testing service, source of concrete aggregates, material manufacturer, brand name of manufactured materials, material name, values as

specified for each material, and test results. Provide certificates for Welder Qualifications that are in accordance with the paragraph entitled, "Qualifications for Welding Work," of this section.

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. 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 to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.6 QUALITY ASSURANCE

1.6.1 Design Data

1.6.1.1 Formwork Calculations

ACI/MCP-4. Include design calculations indicating arrangement of forms, sizes and grades of supports (lumber), panels, and related components. Furnish drawings and calculations of shoring and re-shoring methods proposed for floor and roof slabs, spandrel beams, and other horizontal concrete members.

1.6.2 Drawings

1.6.2.1 Formwork

Drawings showing details of formwork including, but not limited to; joints, supports, studding and shoring, and sequence of form and shoring removal. Reproductions of contract drawings are unacceptable.

1.6.2.2 Reinforcing Steel

ACI/MCP-4. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

1.6.3 Control Submittals

1.6.3.1 Curing Concrete Elements

Submit proposed materials and methods for curing concrete elements.

1.6.3.2 Pumping Concrete

Submit proposed materials and methods for pumping concrete. Submittal must include mix designs, pumping equipment including type of pump and size and material for pipe, and maximum length and height concrete is to be pumped.

1.6.3.3 Form Removal Schedule

Submit schedule for form removal indicating element and minimum length of time for form removal.

1.6.3.4 VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Submit certification for the form release agent, curing compounds, and concrete penetrating sealers that indicate the VOC content of each product.

1.6.3.5 Material Safety Data Sheets

Submit Material Safety Data Sheets (MSDS) for all materials that are regulated for hazardous health effects. Prominently post the MSDS at the construction site.

1.6.4 Test Reports

1.6.4.1 Concrete Mix Design

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix must be suitable for the job conditions. Include mill test and all other test for cement, aggregates, and admixtures in the laboratory test reports. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Submit test reports along with the concrete mix design. Obtain approval before concrete placement.

1.6.4.2 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C 618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date. Submit manufacturer's policy statement on fly ash use in concrete.

1.6.4.3 Ground Granulated Blast-Furnace Slag

Submit test results in accordance with ASTM C 989 for ground granulated blast-furnace slag. Submit test results performed within 6 months of submittal date. Submit manufacturer's policy statement on slag use in concrete.

1.6.4.4 Aggregates

ASTM C 1260 for potential alkali-silica reactions, ASTM C 295 for petrographic analysis.

1.7 ENVIRONMENTAL REQUIREMENTS

Provide space ventilation according to manufacturer recommendations, at a minimum, during and following installation of concrete curing compound and sealer. Maintain one of the following ventilation conditions during the curing compound/sealer curing period or for 72 hours after installation:

a. Supply 100 percent outside air 24 hours a day.

b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 84 degrees F and humidity is between 30 percent and 60 percent.

c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.8 SUSTAINABLE DESIGN REQUIREMENTS

1.8.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

1.8.2 Forest Stewardship Council (FSC) Certification

Use FSC-certified wood where specified. Provide letter of certification signed by lumber supplier. Indicate compliance with FSC STD 01 001 and identify certifying organization. Submit FSC certification numbers; identify each certified product on a line-item basis. Submit copies of invoices bearing the FSC certification numbers.

1.9 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

Perform concrete testing by an approved laboratory and inspection service experienced in sampling and testing concrete. Testing agency must meet the requirements of ASTM E 329.

1.10 CONCRETE SAMPLING AND TESTING

Testing by the Contractor must include sampling and testing concrete materials proposed for use in the work and testing the design mix for each class of concrete. Perform quality control testing during construction.

Sample and test concrete aggregate materials proposed for use in the work in accordance with ASTM C 33.

Sample and test portland cement in accordance with ASTM C 150.

Sample and test air-entraining admixtures in accordance with ASTM C 233.

Testing must be performed by a Grade I Testing Technician.

PART 2 PRODUCTS

2.1 MATERIALS FOR FORMS

Provide wood, plywood, plastic, carton, or steel. Use plywood or steel forms where a smooth form finish is required.

2.1.1 Wood Forms

Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with PS1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining. Submit data verifying that composite wood products contain no urea formaldehyde resins. Virgin wood used must be FSC-certified.

2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to NIST PS 1, B-B, high density form overlay, not less than 5/8-inch thick.

2.1.2 Plastic Forms

Provide plastic forms that contain a minimum of 50 percent post-consumer recycled content, or a minimum of 50 percent post-industrial recycled content.

2.1.3 Carton Forms

Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete until initial set. Provide carton forms that contain a minimum of 5 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content.

2.1.4 Steel Forms

Provide steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORM TIES AND ACCESSORIES

The use of wire alone is prohibited. Provide form ties and accessories that do not reduce the effective cover of the reinforcement.

2.2.1 Dovetail Anchor Slot

Preformed metal slot approximately 1 by 1 inch of not less than 22 gage galvanized steel cast in concrete. Coordinate actual size and throat opening with dovetail anchors and provide with removable filler material.

2.3 CONCRETE

2.3.1 Contractor-Furnished Mix Design

ACI/MCP-1, ACI/MCP-2, and ACI/MCP-2, except as otherwise specified. The compressive strength (f'c) flexural strength (R) of the concrete for each portion of the structure(s) shall be as indicated 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)
All areas	4,000	57	1-4	0.45-0.50	1-3
Encasement	3,000	57	1-4	0.45-0.50	1-3
Airfield Pavment & Driveways	650 psi (R, Min. 28-day Flexural Strength)	57	1 - 3	0.45	5 - 6

Maximum slump shown above may be increased 1 inch for methods of consolidation other than vibration. Slump may be increased to 8 inches when superplasticizers are used. Provide air entrainment using air-entraining admixture. Air entrainment shall be within plus or minus 1.5 percent of the value specified. The water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days shall not exceed 0.15. Concrete used for electrical duct bank encasement shall be colored red.

Note (a): Entrapped air shall be 3% or less.

Proportion concrete mixes for strength at 56 days.

2.3.1.1 Mix Proportions for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified are the responsibility of the Contractor. Base mixture proportions on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M. Samples of all materials used in mixture proportioning studies must be representative of those proposed for use in the project and must be accompanied by the manufacturer's or producer's test report indicating compliance with these specifications. Base trial mixtures having proportions, consistencies, and air content suitable for the work on methodology described in ACI/MCP-1. In the trial mixture, use at least three different water-cement ratios for each type of mixture, which must produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratio required must be based on equivalent water-cement ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan, and ground granulated blast-furnace slag by weight equivalency method. Design laboratory trial mixture for maximum permitted slump and air content. Each combination of material proposed for use must have

separate trial mixture, except for accelerator or retarder use can be provided without separate trial mixture. Report the temperature of concrete in each trial batch. For each general purpose mix design (as indicated)and 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 day compressive strength. Alternatively, for each pavement and driveway mix design and water-cement ratio, at least three test beams for each test age must be made and cured in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 78 for 7 and 28 day flexural strength. From these results, plot curves showing the relationship between water-cement ratio and strength (compressive or flexural, as applicable) for each set of trial mix studies. In addition, plot curves showing the relationship between 7 and 28 day strengths (compressive or flexural, as applicable).

2.3.1.2 Required Average Strength of Mix Design

The selected mixture must produce an average strength (compressive or flexural, as applicable) 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 or flexural strength must be determined in accordance with ACI/MCP-2. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength must follow ACI/MCP-2 requirements.

2.3.2 Ready-Mix Concrete

Provide concrete that meets the requirements of ASTM C 94/C 94M.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by ASTM C 94/C 94M:

Type and brand cement

Cement content in 95-pound bags per cubic yard of concrete

Maximum size of aggregate

Amount and brand name of admixtures

Total water content expressed by water/cement ratio

2.3.3 Concrete Curing Materials

2.3.3.1 Absorptive Cover

Provide burlap cloth cover for curing concrete made from jute or kenaf, weighing 10 ounces plus or minus 5 percent per square yard when clean and dry, conforming to ASTM C 171, Class 3; or cover may be cotton mats as approved.

2.3.3.2 Moisture-Retaining Cover

Provide waterproof paper cover for curing concrete conforming to ASTM C 171, regular or white, or polyethylene sheeting conforming to ASTM C 171, or polyethylene-coated burlap consisting of a laminate of burlap and a white opaque polyethylene film permanently bonded to the burlap; burlap must

conform to ASTM C 171, Class 3, and polyethylene film must conform to ASTM C 171. When tested for water retention in accordance with ASTM C 156, weight of water lost 72 hours after application of moisture retaining covering material must not exceed 0.039 gram per square centimeter of the mortar specimen surface.

2.3.3.3 Membrane-Forming Curing Compound

Provide liquid type compound conforming to ASTM C 309, Type 1, clear, Type 1D with fugitive dye for interior work and Type 2, white, pigmented for exterior work.

2.4 MATERIALS

2.4.1 Cement

ASTM C 150, Type II or Type V or ASTM C 595, Type IP(MS) or IS(MS) blended cement except as modified herein. Provide blended cement that consists of a mixture of ASTM C 150, Type V, 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 the hazardous waste is neutralized by the manufacturing process and that no additional pollutants are discharged.

2.4.1.1 Fly Ash and Pozzolan

ASTM C 618, Types 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 GGBF slag: 50 percent.

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

2.4.1.2 Ground Granulated Blast-Furnace Slag

ASTM C 989, Grade 80. Slag content must be a minimum of 25 percent by weight of cementitious material.

2.4.1.3 Portland Cement

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

finished surfaces.

2.4.2 Water

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

2.4.3 Aggregates

ASTM C 33, 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.

Fine and coarse aggregates must show expansions less than 0.08 percent at 16 days after casting when testing in accordance with ASTM C 1260. Should the test data indicate an expansion of 0.08 percent or greater, reject the aggregate(s) or perform additional testing using ASTM C 1567 using the Contractor's proposed mix design. In this case, include the mix design low alkali portland cement and one of the following supplementary cementitious materials:

1. GGBF slag at a minimum of 40 percent of total cementitious

2. Fly ash or natural pozzolan at a minimum of total cementitious of
   a. 30 percent if ($SiO_2+Al_2O_3+Fe_2O_3$) is 65 percent or more,
   b. 25 percent if ($SiO_2+Al_2O_3+Fe_2O_3$) is 70 percent or more,
   c. 20 percent if ($SiO_2+Al_2O_3+Fe_2O_3$) is 80 percent or more,
   d. 15 percent if ($SiO_2+Al_2O_3+Fe_2O_3$) is 90 percent or more.

If a combination of these materials is chosen, the minimum amount must be a linear combination of the minimum amounts above. Include these materials in sufficient proportion to show less than 0.08 percent expansion at 16 days after casting when tested in accordance with ASTM C 1567.

Aggregates must not possess properties or constituents that are known to have specific unfavorable effects in concrete when tested in accordance with ASTM C 295.

2.4.3.1 Recycled Aggregate Materials

Use a minimum of 25 percent recycled aggregate, depending on local availability and conforming to requirements of the mix design. Recycled aggregate to include: recovered glass, recovered concrete, recovered porcelain, recovered stone, that meets the aggregate requirements specified. Submit recycled material request with the aggregate certification submittals and do not use until approved by the Contracting Officer.

2.4.4 Nonshrink Grout

ASTM C 1107/C 1107M.

2.4.5 Admixtures

ASTM C 494/C 494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures.

2.4.5.1 Air-Entraining

ASTM C 260.

2.4.5.2 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C 494/C 494M, Type F and Type G (HRWR retarding admixture) and ASTM C 1017/C 1017M.

2.4.5.3 Pozzolan

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

2.4.6 Materials for Curing Concrete

Use water-based curing compounds, sealers, and coatings with low (maximum 160 grams/liter, less water and less exempt compounds) VOC content.

Consider the use of water based or vegetable or soy based curing agents in lieu of petroleum based products. Consider agents that are not toxic and emit low or no Volatile Organic Compounds (VOC). Consider the use of admixtures that offer high performance to increase durability of the finish product but also have low toxicity and are made from bio-based materials such as soy, and emit low levels of Volatile Organic Compounds (VOC).

2.4.6.1 Impervious Sheeting

ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.4.6.2 Pervious Sheeting

AASHTO M 182.

2.4.6.3 Liquid Membrane-Forming Compound

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

2.4.7 Expansion/Contraction Joint Filler

ASTM D 1751, ASTM D 1752, cork or 100% post-consumer paper meeting ASTM D 1752 (subparagraphs 5.1 to 5.4). Material must be 1/2 inch thick, unless otherwise indicated.

2.4.7.1 Preformed Joint Filler Strips

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

Provide nonextruding and resilient nonbituminous type filler strips conforming to ASTM D 1752, Type I or II.

2.4.8 Joint Sealants

Use concrete penetrating sealers with a low (maximum 100 grams/liter, less water and less exempt compounds) VOC content.

2.4.8.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D 7116 for surfaces subjected to jet fuel.

2.4.8.2 Vertical Surfaces Greater Than 3 Percent Slope

FS SS-S-200, no sag.

2.4.8.3 Joint Sealant Compound

Provide cold-applied, two-component, elastomeric polymer type compound conforming to FS SS-S-200.

2.4.9 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.

2.4.10 Biodegradable Form Release Agent

Provide form release agent that is colorless, biodegradable, and rapeseed oil-based, soy oil-based, or water-based, with a low (maximum of 55 grams/liter (g/l)) VOC content. A minimum of 85 percent of the total product must be biobased material. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene.

2.5 REINFORCEMENT

Galvanize connectors and chairs.

2.5.1 Reinforcing Bars

ACI/MCP-2 unless otherwise specified. Use deformed steel.
ASTM A 615/A 615M and AASHTO M 53 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. ASTM A 706/A 706M. Provide reinforcing bars that contain a minimum of 100 percent recycled content. Reinforcing bars may contain post-consumer or post-industrial recycled content.

2.5.1.1 Weldable Reinforcing Bars

Provide weldable reinforcing bars that conform to ASTM A 706/A 706M and ASTM A 615/A 615M and Supplement S1, Grade 60, except that the maximum carbon content must be 0.55 percent.

2.5.2 Mechanical Reinforcing Bar Connectors

ACI/MCP-2. Provide 125 percent minimum yield strength of the reinforcement bar.

2.5.3 Wire

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

2.5.3.1 Welded Wire Fabric

ASTM A 185/A 185M or ASTM A 497/A 497M. Provide fabric that contains a minimum of 50 percent recycled content. Wire fabric may contain post-consumer or post-industrial recycled content. Provide flat sheets of welded wire fabric for slabs and toppings.

2.5.3.2 Steel Wire

Wire must conform to ASTM A 82/A 82M.

2.5.4 Reinforcing Bar Supports

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

2.5.5 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 MSP-2.

Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

2.6 BONDING MATERIALS

2.6.1 Concrete Bonding Agent

Provide aqueous-phase, film-forming, nonoxidizing, freeze and thaw-resistant compound agent suitable for brush or spray application conforming to ASTM C 932.

2.6.2 Epoxy-Resin Adhesive Binder

Provide two-component, epoxy-polysulfide polymer type binder with an amine-type curing-agent conforming to FS MMM-A-001993, Type I or ASTM C 881/C 881M.

2.7 CLASSIFICATION AND QUALITY OF CONCRETE

2.7.1 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 foundation concrete work exposed to freezing and thawing or subjected to hydraulic pressure, such as foundation walls, grade beams, pits, tunnels. For exterior concrete slabs, such as steps, platforms, walks
5A	5,000	Air-entrained	For structural concrete work as indicated

2.7.2 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	0.50	5.25
5A	0.41	6.5

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

2.7.3 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
2 inches	357	Nonreinforced footings and other flat work having a depth of not less than 6 inches, and nonreinforced walls and other formed sections having a dimension between forms of not less than 10 inches

MAXIMUM SIZE OF AGGREGATE	ASTM C 33 SIZE NUMBER	TYPE OF CONSTRUCTION
1-1/2 inches	467	Monolithic slabs on ground, concrete fill, and other flat-work having a depth of not less than 5 inches and a clear distance between reinforcing bars of not less than 2 inches
1 inch	57	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 than 1.5 inches
3/4 inch	67	Reinforced walls, columns, girders, beams, and other formed sections having a dimen-sion 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 than 1 inch
1/2 inch	7	Concrete joist construction, beams, reinforced walls, and other formed work having a clear distance between rein-forcing bars and face of form of less than 1 inch
3/8 inch	8	Nonreinforced slabs and other flatwork having a depth of less than 2-1/2 inches

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

Specify gradation of aggregates for separate floor topping.

2.7.4 Slump

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

TYPE OF CONSTRUCTION	SLUMP
Footings, unreinforced	Not less than 1 inch nor more

TYPE OF CONSTRUCTION	SLUMP
walls	than 3 inches
Columns, beams, reinforced walls, monolithic slabs	Not less than 1 inch nor more than 4 inches
Ramps and other sloping surfaces	0 nor more than 3 inches

2.7.5 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
		1 - 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 the 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 the 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, snow, ice, and other deleterious substances before start of concrete placing.

Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings

When subgrade material is semiporous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited. When subgrade material is porous, seal subgrade surface by covering surface with specified 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.

Install subgrade cover to avoid puncture or tear. Patch punctures or tears over 12 inches with separate sheets lapped not less than 6 inches. Seal all punctures or tears less than 12 inches with pressure-sensitive vapor barrier tape not less than 2-inches wide. Seal lapped joints with vapor barrier adhesive or pressure-sensitive vapor barrier tape not less than 2-inches wide. Lay subgrade cover sheets with not less than a 6-inch lap at edges and ends and in direction in which concrete is to be placed.

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 client 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. AWS D1.4/D1.4M. Approve welded splices prior to use. Repair the cut ends of hot-dipped galvanized reinforcement steel to completely coat exposed steel, ASTM A 780.

3.5.4 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Provide bolt threads that match the connector. Countersink the connector in the concrete. Caulk the depression after the bolt is installed.

3.5.5 Cover

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

3.5.6 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.5.7 Construction Joints

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

3.5.8 Expansion Joints and Contraction Joints

Provide expansion joint at edges of interior floor slabs on grade abutting vertical surfaces, and as indicated. Make expansion joints 1/2 inch wide unless indicated otherwise. Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used. Provide contraction joints, either formed or saw cut or cut with a jointing tool, to the indicated depth after the surface has been finished. Complete saw joints within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

3.5.9 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

Provide fabrication tolerances that are in accordance with ACI/MCP-1, ACI/MCP-2 and ACI/MCP-3.

Provide hooks and bends that are in accordance with 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.

3.5.10 Placing Reinforcement

Place reinforcement in accordance withACI/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 MSP-2. 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 ACI/MCP-4.

3.5.11 Spacing of Reinforcing Bars

Spacing must be as indicated. If not indicated, spacing must be in accordance with theACI/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.

3.5.12 Concrete Protection for Reinforcement

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

3.5.13 Welding

Welding must be in accordance with AWS D1.4/D1.4M.

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 and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other. Position grade stakes on 10 foot centers maximum in each direction when pouring interior slabs and on 20 foot centers maximum for exterior slabs.

3.7.1 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 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 20 inches apart. Penetrate the previously placed lift with the vibrator when more than one lift is required. Place concrete in 20 inch maximum vertical lifts. Use external vibrators on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.

3.7.4 Application of Epoxy Bonding Compound

Apply a thin coat of compound to dry, clean surfaces. Scrub compound into the surface with a stiff-bristle brush. Place concrete while compound is stringy. Do not permit compound to harden prior to concrete placement. Follow manufacturer's instructions regarding safety and health precautions when working with epoxy resins.

3.7.5 Pumping

ACI/MCP-2. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 2 inches. Do 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.

3.7.6 Cold Weather

ACI/MCP-2. Do not allow concrete temperature to decrease below 50 degrees F. Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 37 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application.

3.7.7 Hot Weather

Maintain required concrete temperature using Figure 2.1.5 in ACI/MCP-2 to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.7.8 Follow-up

Check concrete within 24 hours of placement for flatness, levelness, and other specified tolerances. Adjust formwork and placement techniques on subsequent pours to achieve specified tolerances.

3.7.9 Placing Concrete in Forms

Deposit concrete placed in forms in horizontal layers not exceeding 24 inches.

Remove temporary spreaders in forms when concrete placing has reached elevation of spreaders.

Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Design vibrators to operate with vibratory element submerged in concrete and maintain a speed of not less than 9,000 impulses per minute when submerged in concrete.

Provide vibrating equipment adequate in number of units and power of each unit to properly consolidate concrete. Vibration of forms and reinforcement is not be permitted. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced points not farther apart than visible effectiveness of machine. Do not insert vibrator into lower courses of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of concrete mix.

Do not start placing of concrete in supporting elements until concrete previously placed in columns and walls is no longer plastic and has been in place a minimum of 2 hours.

3.7.10 Placing Concrete Slabs

Place and consolidate concrete for slabs in a continuous operation, within the limits of approved construction joints until placing of panel or section is completed.

During concrete placing operations, consolidate concrete by mechanical vibrating equipment so that concrete is worked around reinforcement and other embedded items and into corners. Consolidate concrete placed in beams and girders of supported slabs and against bulkheads of slabs on ground by mechanical vibrators as specified. Consolidate concrete in remainder of slabs by vibrating bridge screeds, roller pipe screeds, or other approved method. Limit consolidation operations to time necessary to obtain consolidation of concrete without bringing an excess of fine aggregate to the surface. Concrete to be consolidated must be as dry as practical and surfaces thereof must not be manipulated prior to finishing operations. Bring concrete correct level with a straightedge and struck-off. Use bull floats or darbies to smooth surface, leaving it free of humps or hollows. Sprinkling of water on plastic surface is not permitted.

Provide finish of slabs as specified.

3.7.11 Bonding

Surfaces of set concrete at joints, except where bonding is obtained by use of concrete bonding agent, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.

At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.

Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

Bonding of fresh concrete to concrete that has set may be obtained by use of a concrete bonding agent. Apply such bonding material to cleaned concrete surface in accordance with approved printed instructions of bonding material manufacturer.

3.8 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.

3.9 SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI/MCP-2, unless otherwise specified. Slope slabs uniformly to drains where drains are provided. Where straightedge measurements are specified, Contractor must provide straightedge.

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 Floated

Use for exterior slabs where not otherwise specified. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float must begin when the surface has stiffened sufficiently to permit the operation. During or after the first floating, check surface with a 10 foot straightedge applied at no less than two different angles, one of which is perpendicular to the direction of strike off. Cut down high spots and fill low spots during this procedure to produce a surface level within 1/4 inch in 10 feet.

3.9.1.2 Steel Troweled

Use for floors intended as walking surfaces. 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.

3.9.1.3 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.

3.9.1.4 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 or burlap drag at the Contractor's option. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but gritty nonslip surface is obtained. OR drag a strip of clean, wet burlap from 3 to 10 feet wide and 2 feet longer than the pavement width across the slab. Produce a fine, granular, sandy textured surface without disfiguring marks. Round edges and joints with an edger having a radius of 1/8 inch.

3.9.2 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.

3.9.4 Curbs and Gutters

Provide contraction joints spaced every 10 feet maximum unless otherwise indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum unless otherwise indicated. Perform pavement finish.

3.10 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..

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 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Provide sheeting that is at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.10.2.4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.10.3 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 Curing Periods

ACI/MCP-2 except 10 days for retaining walls or pavements, 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.

3.10.5 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.

3.10.6 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.

3.10.7 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.

3.10.8 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.

3.10.9 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.

3.10.10 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 or beams 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 or beams 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 100 cubic yards of concrete, nor less than once for each 5000 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 Flexural Concrete Tests

3.11.2.4.1 Flexural Strength

During progress of work verify flexural strength by testing beams made from concrete taken from the delivery vehicle at intervals specified herein. Mold and cure beams in accordance with ASTM C 31/C 31M. Perform tests in accordance with ASTM C 78. Mold at least eight beams each day from

concrete placed that day. Select one group of four beams near the beginning of the work and a second group of four beams from the final third of concrete to be placed that day. Ensure an approved laboratory furnishes necessary labor, concrete and facilities for molding, handling, and storing the beams at the site of the work and testing beams. Perform tests at 28 days. Earlier tests may be performed at the contractor's request, with no additional cost to the Government. Concrete must meet the following requirements:

(1) From each group of four beams, three beams tested at the end of 90 days must have an average flexural strength equal to or greater than the specified strength. Do not conside specimens obviously defective in the determination of the strengths.

(2) No individual beam of the three beams tested shall have a flexural strength less than 600 psi (600 psi). Discard defective beams.

e. Flexural Strength: During progress of work verify flexural strength by testing beams made from concrete taken from the delivery vehicle at intervals specified herein. Mold and cure beams in accordance with ASTM C 31/C 31M. Perform tests in accordance with ASTM C 78. Mold at least eight beams each day from concrete placed that day. Select one group of four beams near the beginning of the work and a second group of four beams from the final third of concrete to be placed that day. Ensure an approved laboratory furnishes necessary labor, concrete and facilities for molding, handling, and storing the beams at the site of the work and testing beams. Perform tests at 28 days. Earlier tests may be performed at the contractor's request, with no additional cost to the Government. Concrete must meet the following requirements:

(1) From each group of four beams, three beams tested at the end of 90 days must have an average flexural strength equal to or greater than the specified strength. Do not conside specimens obviously defective in the determination of the strengths.

(2) No individual beam of the three beams tested shall have a flexural strength less than 600 psi (600 psi). Discard defective beams.

3.11.2.5 Field Testing

a. Concrete Slump: Test consistency of concrete slump in accordance with ASTM C 143/C 143M. Determine consistency of concrete at the start of each day's concrete placement and for each group of test specimens.

b. Air Content: Determine air content at the start of concrete placement and for each group of test specimens. Record results with test specimens. Determine air content in accordance with ASTM C 231.

c. Surface Tests: Perform straightedge testing in accordance with paragraph: Surface Testing. Where defective areas of pavement are removed or replaced, the portion of the slab which remains in the pavement abutting the replacement slab shall have length and width

not less than 10 feet from the nearest edge or joint.

d. Test for Pavement Thickness: Obtain 4 inch diameter core samples to determine in-place thickness of concrete pavement. Obtain cores in accordance with ASTM C 42/C 42M. Remove cores at varying intervals but in no case less than two cores for each 1000 square yards. Repair core holes with non-shrink grout. Measure cores in accordance with ASTM C 174/C 174M. A tolerance in pavement thickness of plus or minus 1/2 inch is permitted for individual core; however, the average thickness of cores must be at least 6 inches. When determining the average, assign cores with a thickness of more than 1/2 inch greater than specified, a thickness of the specified thickness plus 1/2 inch. If measured pavement thickness is less than that shown by more than 1/2 inch, remove deficient areas and replace with pavement of the specified strength, quality and thickness. When a core indicates unsatisfactory thickness, determine limits of the pavement to be removed and replaced as follows: Take one core for each slab of lane in question in both directions from unsatisfactory core until satisfactory thickness is indicated; remove and replace pavement in each panel, for the full width of the lane, in which a core indicated unsatisfactory thickness. Include the following information in each of the reports of corings:

(1) Date concrete represented by core was placed

(2) Date core was taken

(3) Location of Core: Lane number, station number

(4) Thickness of core

(5) Condition of Core: Appearance, concrete texture, condition of bottom of core

(6) Disposition of Cores: In Contracting Officer or Contractor possession.

3.11.2.6 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 or flexural 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

3.11.2.7 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 or flexural 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 or flexural 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 or an on-site area to be paved later in project for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.12.2 Hardened, Cured Waste Concrete

Crush and reuse hardened, cured waste concrete as fill or as a base course for pavement. Use hardened, cured waste concrete as aggregate in concrete mix if approved by Contracting Officer.

3.12.3 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.12.4 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material. Return excess cement to supplier. Institute

deconstruction and construction waste separation and recycling for use in manufacturer's programs. When such a program is not available, seek local recyclers to reclaim the materials.

3.13 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:

a. In walls at not more than 60 feet in any horizontal direction; at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall

b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier

c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

d. In slabs on ground, so as to divide slab into areas not in excess of 1,200 square feet

Provide keyways at least 1-1/2-inches deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

Joints must be perpendicular to main reinforcement. Reinforcement must be continued across construction joints.

3.13.2 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 Control Joints in Slabs on Ground

Provide joints to form panels as indicated.

Under and on exact line of each control 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 control joints which are to receive floor or pavement finish 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 control 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.

-- End of Section --