Attachment A

SPECIFICATIONS FOR

FY14 REPAIR ELECTRICAL SYSTEMS PHASE II – HIGH VOLTAGE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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SECTION 01 11 00.98

SUMMARY OF WORK
12/12

PART 1 GENERAL

1.1 SUMMARY

The work to be performed under this project consists of providing the labor, equipment, and materials to purchase and replace the 2.4 kV "WD1" and a portion of "WB4" switchgear, the 34.5/2.4 kV transformer "B2" in Substation "B", the 34.5 kV oil circuit breakers "RK7L", "RK8M', RK9N", and "RK10P" with SF6 units, and the obsolete backup relaying on Substation "A" 138 kV lines "QA8B", "QA9C", and "QA10D" with modern micro-processor-based relaying. There will be 2 options as follows: Option 1: Purchase and install 2 additional 2.4 kV breakers with controls in the new "WD1" switchgear line-up. Option 2: Purchase and replace 2.4 kV "WD1MAIN" cable..

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00.98 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

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

Submit the following items to the Contracting Officer:

Site Specific Health and Safety Plan (HASP) G
Utility Outages G
Confined Space Permits G
Connection Requests G
Digging, Excavating, and Trenching Permits G
Soil Relocation Form Permits G
Hot Work Permits G

1.3 CONTRACT DRAWINGS

Contractors shall purchase drawings from vendor. Reference publications will not be furnished.

Contractor shall immediately check furnished drawings and notify the Government of any discrepancies.

1.4 WORK RESCHEDULING

Contractor shall allow for a maximum of 5 days where construction activity is prohibitive. Further allowance for 5 days of excavation and subsurface activity abeyance shall be imposed where other construction activities are permitted. Government will provide 24 hour notification each time the restrictions are invoked.

Normal duty hours for work shall be from 7 a.m. to 3:30 p.m., Monday through Friday. Requests for additional work shall require written approval from the Contracting Officer 7 days in advance of the proposed work period. Special permission will be given in other circumstances on a case by case basis.

1.5 OCCUPANCY OF PREMISES

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

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

1.6 GOVERNMENT FURNISHED PROPERTY

Government will not furnish to the Contractor any property.

1.7 ON-SITE PERMITS

1.7.1 Utility Outages and Connection Requests

Work shall be scheduled to hold outages to a minimum.

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

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

Requests for utility outages and connections shall be made in writing to the Contracting Officer at least 5 working days in advance of the time required. Each request shall state the system involved, area involved, approximate duration of outage, and the nature of work involved.

1.7.2 Permit Requested Lead Times and Forms

ACTIVITY	SUBMISSION DATE	SUBMISSION FORM
Hot Work Permits	7 days prior to work	NASA Form C-7A & NASA Form C-7B
Confined Space	7 days prior to work	NASA Form C-199, C-199B and C-199C
Digging, Excavating and Trenching Permit	21 days prior to work	NASA Form C-927
Soil Relocation Authorization	7 days prior to work	NASA Form C-9436

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

Burning of trash or rubbish is not permitted.

1.8 SALVAGE MATERIAL AND EQUIPMENT

Items of material designated by the Contracting Officer to be salvage shall remain the property of the Government.

It shall be segregated, itemized, delivered, and off-loaded at the Government designated storage area.

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

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 30 00.98.98

ADMINISTRATIVE REQUIREMENTS
12/12

PART 1 GENERAL

1.1 SUMMARY

A. This section includes:
1. Project management and coordination.
2. Construction progress documentation.
3. Submittal procedures and general requirements for Submittals.

1.2 PROJECT MANAGEMENT AND COORDINATION - ENVIRONMENTAL

A. Contractor's Environmental Manager: Designate an on-site party responsible for overseeing the Contractor's conformance to environmental goals for the project and implementing procedures for environmental protection.

1. Qualifications: Minimum 5 years construction experience on projects of similar size and scope; minimum 3 years experience with environmental procedures similar to those of this project; familiarity with Environmental Management Systems (EMS's) such as ISO 14001; familiarity with environmental regulations applicable to construction operations.

2. Responsibilities: Responsibilities shall include:
   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 IAQ Management Plan.
   d. Implementation of the Environmental Protection Plan.
   e. Training for Contractor personnel in accordance with their position requirements.
   f. Monitoring and documentation of environmental procedures.

B. Health Safety Manager: Contractor's Health and Safety Manager shall have been employed as a health and safety specialist on construction job sites, serving in either a full-time or part-time position and responsible for safety and health on one or more construction projects of a similar size and scope to this project. The Manger shall have a high school diploma and be qualified as an OSHA authorized instruction or have 40 hours of classroom training in construction safety and health or have an associate degree or higher in safety and health. The Manager shall also have at least three years of experience in a construction related position.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01 33 00.98 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

List of contact personnel; G,

View location map; G,

1.4 CONTRACTOR PERSONNEL REQUIREMENTS

1.4.1 Subcontractors and Personnel

Furnish a list of contact personnel of the Contractor and subcontractors including addresses and telephone numbers for use in the event of an emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.4.2 Identification Badges

Temporary identification badges, if required, will be furnished without charge. Application for and use of badges will be as directed. Immediately report instances of lost or stolen badges to the Contracting Officer. All badges must be returned to NASA upon expiration of the badge or contact, or termination of the employee. Immediately report instances of lost or stolen badges to the Contracting Officer.

1.5 PERSONNEL LIST

Submit for approval, at least 15 days prior to the desired date of entry, an original alphabetical list of personnel who require entry into Government property to perform work on the project. Furnish for each person:

a. Name

b. Date and place of birth

c. Citizenship

d. Home address

1.6 SUPERVISION

Provide at least one (1) qualified Project Manager and one (1) on-site Project Superintendent. The Project Manager must have a minimum 5 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.

The Project Manager in this context shall mean the individual with the responsibility for the overall management of the project and the Project Superintendent shall mean the individual with the responsibility for quality and production. Both the Project Manager and Project Superintendent are subject to removal by the Contracting Officer for non-compliance with requirements specified in the contract and for failure to manage the project to insure 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.

1.7 PRECONSTRUCTION CONFERENCE

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

1.8 FACILITY TURNOVER PLANNING MEETINGS

Key personnel will meet to identify strategies to ensure the project is carried to expeditious closure and turnover to the Client. Start the turnover process at the Pre Construction Conference meeting and convene the Facility Turnover Meetings once the project has reached approximately 75% completion or three to six months prior to Beneficial Occupancy Date (BOD), whichever comes first. The Contracting Officer's Representative will lead the meetings and guide discussions based on an agenda provided by the Government. The facility Turnover effort shall include the following:

a. Facility Turnover Meetings

1. Fill in the Checklist including Contractor, Client, and NASA Checklist Items and assign a person responsible for each item and a due date. The Contractor's Representative will facilitate the assignment of responsibilities and fill out the NASA Checklist.

2. Review the Contractor's updated schedule. The Contractor shall develop a plan for the completion of all Contractor, Client, and NAVFAC Checklist items.

3. Confirm that all Checklist items will be completed on time for the scheduled Facility Turnover.

1.9 PARTNERING

LEVEL C PARTNERING: To most effectively accomplish this contract, the Government requires the formation of a cohesive partnership with the Contractor and its subcontractors. The partnership will draw on the strength of each organization in an effort to achieve a quality project done right the first time, within budget, on schedule, and without any safety mishaps. This level of partnering discusses partnering concepts and benefits and should become a part of the preconstruction conference. The senior Government representative and senior Contractor representative present will jointly host the partnering sessions. The partners will determine the frequency of the follow-on sessions. Partnering sessions should be held at or near the location of the activity contracting office. The participants shall bear their own costs for meals, lodging, and transportation associated with partnering.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 31 19.98

PROJECT MEETINGS
12/12

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 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00.98 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

A Project Submittal Schedule shall be submitted in accordance with paragraph entitled, "Project Meetings," of this section.

The Contractor shall submit a Monthly Progress Report at the first meeting of each month.

1.3 PRECONSTRUCTION CONFERENCE

The Contractor shall attend a preconstruction conference scheduled by the Contracting Officer. Work shall not commence prior to the conference. Subcontractor representatives shall attend.

Discussion shall address project orientation, personnel contact, safety issues, permits, deficiencies, and the location of the Contractor's office.

1.4 PROJECT MEETINGS

The Contractor shall attend weekly project meetings scheduled by the Government. Subcontractor representatives shall attend.

Prepare a Two-Week Planning Schedule for each weekly project meeting. highlighting utility outages, material deliveries, subcontractors onsite, equipment on site, coordination issues and updates to the master schedule described in Section 01 33 00.98, "Submittal Procedures".

Meeting Minutes shall be kept by the Quality Assurance Specialist (QA) and distributed after concurrence by the Project Manager.

A Monthly Progress Report shall be submitted by the contractor to NASA which addresses the progress schedule, potential factors of delay, deficiencies, material delivery schedules, submittals, and safety issues.

A Project Submittal Schedule shall be submitted showing full coordination with the project schedule. All products and tests under each submittal number shall be prioritized and linked to the progress schedule.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 33 00

SUBMITTAL PROCEDURES
05/13

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications for projects completed at Glenn Research Center (GRC) and Plum Brook Station (PBS).

1.2 SUBMITTALS

A standard contractor developed transmittal form shall be used to transmit each submittal.

Submittal Description (SD): Drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials to be furnished by the Contractor explaining in detail specific portions of the work required by the contract.

The following items, SD-01 through SD-11, are descriptions of data to be submitted for the project. The requirements to actually furnish the applicable items will be called out in each specification.

However, as a minimum, provide test reports, installation, operation and maintenance submittals and manuals. Equipment actually installed will be clearly marked.

Submittals may be provided in an electronic format such as PDF's on some NASA projects. The Contractor will receive additional information on processing electronic submittals at the preconstruction conference.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only.

SD-01 Preconstruction Submittals

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

SD-02 Shop Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, detail of fabrications, layout of particular elements, connections, and other relational aspects of the work. Upon approval by the Government, shop drawings shall be provided in an electronic pdf file format on compact disc(s).

SD-03 Product Data

Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Upon approval by the Government, this data shall be provided in an electronic pdf file format on compact disc(s).

SD-04 Samples

Samples, including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work.

SD-06 Test Reports

Written reports of a manufacturer's findings of his product during field inspections, attesting that the products are installed in accordance with the manufacturer's installation instructions, shop drawings, or other manufacturer's requirements. Written reports by a general contractor or his subcontractors including daily logs reporting on the progress of daily activities or attesting that the work has been installed in accordance with the contract plans and specifications.

SD-07 Certificates

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other Lower Tier Contractor, the purpose of which is to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verification of quality.

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.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system, or material, including special notices and material safety data sheets, if any concerning impedances, hazards, and safety precautions. These materials shall be provided in an electronic pdf file format on compact disc(s).

SD-10 Operation and Maintenance Data

Data intended to be incorporated in an operations and maintenance manual. Operation and Maintenance Data shall be provided in an electronic pdf file format on compact disc(s).

For each new mechanical or electrical equipment provided, a completed NASA Form C-134 "CMMS Request for Modifications" shall be submitted.

SD-11 Closeout Submittals

Special requirements necessary to properly close out a construction contract. For example, as-built record drawings, manufacturer's help and product lines necessary to maintain and install equipment. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.3 PREPARATION

1.3.1 Marking

Prepare, review and stamp with Contractor's approval all specified submittals.

Permanently mark each submittal to identify it by contract number; NASA Project I.D. number; transmittal date; Contractor's, Subcontractor's, and supplier's name, address(es) and telephone number(s); submittal name; specification or drawing reference; and similar information to distinguish it from other submittals. Submittal identification shall include space to receive the review action by the Contracting Officer.

1.3.2 Drawing Format

Drawing submittals shall be prepared on NASA GRC AutoCAD electronic standard title block frame not less than 11 by 17 inches nor larger than 35 by 48 inches in size. Drawings shall be prepared to accurate size, with scale indicated, unless other form is required.

Copies of each drawing shall have the following information clearly marked thereon:

a. Job name, which shall be the general title of the contract drawings.

b. Date of the drawings and revisions.

c. Name of Contractor.

d. Name of Subcontractor.

e. Name of the item, material, or equipment detailed thereon.

f. Submittal number (e.g., first submittal to last submittal) in a uniform location adjacent to the title block.

g. Specification section to which submittal applies.

h. Government contract number shall appear in the margin, immediately below the title block.

Drawings shall be numbered in accordance with NASA GRC standards. Each drawing shall bear the number of the submittal in a uniform location adjacent to the title block. Government contract number shall appear in the margin, immediately below the title block, for each drawing.

A blank space, no smaller than 2 inches shall be reserved on the right hand side of each sheet for the Government disposition stamp.

1.3.3 Data Format

Required data submittals for each specific material, product, unit of work, or system shall be collected into a single submittal and marked for choices, options, and portions applicable to the submittal. Marking of each copy of product data submitted shall be identical. Partial submittals will not be accepted for expedition of construction effort.

1.3.4 Samples

Samples shall be physically identical with the proposed material or product to be incorporated in the work, fully fabricated and finished in the specified manner, and full scale. Where variations in color, finish, pattern, or texture are inherent in the material or product represented by the sample, multiple units of the sample, showing the near-limits of the variations and the "average" of the whole range (not less than 3 units), shall be submitted. Each unit shall be marked to describe its relation to the range of the variation. Where samples are specified for selection of color, finish, pattern, or texture, the full set of available choices shall be submitted for the material or product specified. Sizes and quantities of samples shall represent their respective standard unit.

1.4 SUBMISSION REQUIREMENTS

1.4.1 Schedules

Within 15 calendar days of notice to proceed, provide, for approval by the Contracting Officer, the following schedule of submittals:

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

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

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

d. Re-submit copies of both schedules and annotate monthly by the Contractor with actual submission and approval dates. When all items on a schedule have been fully approved, no further re-submittal of the schedule is required.

e. Provide one (1) hard copy and one (1) CD with planned submittals filed in a PDF format. CD shall contain a text file indicating

list of planned submittals.

1.4.2 Drawings Submittals

Submit six (6) full size copy(s) of each drawing. 3 prints, marked with review notations by the Contracting Officer, will be returned to the Contractor. All required installation, fabrication and connection drawings shall be submitted and approved prior to the start of work detailed on these drawings.

Upon project completion, Contractor shall submit two (2) sets of the final drawings along with two (2) CD's containing PDF and DWG files of all approved drawings submitted.

1.4.3 Data Submittals

Submit six (6) complete sets of indexed and bound product data. Three sets, marked with review notations by the Contracting Officer, will be returned to the Contractor.

At the completion of the project the Contractor shall submit 2 sets of bound data along with two (2) electronic CDs containing PDF files of all data submitted.

1.4.4 Samples

Submit two (2) sets of identified samples. A copy of the transmittal form, marked with review notations including selections by the Contracting Officer, will be returned to the Contractor.

Samples that are intended or permitted to be returned and actually incorporated in the work are so indicated in the individual technical sections. These samples will be returned to the Contractor, at his expense, to be clearly labeled, with installation location recorded. Samples shall be in undamaged condition at the time of installation.

Where mockups and similar large samples are required by individual technical sections, it is recognized that these are a special type of sample which cannot be readily "transmitted" as specified for submittal of samples. Otherwise, and except as indicated in the individual technical sections, the requirements for samples shall be complied with and a transmittal form shall be processed for each mockup, to provide a record of the activity.

1.5 GOVERNMENT'S REVIEW

1.5.1 Review Notations

Contracting Officer will review submittals and provide pertinent notation within two (2) calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "approved", "previously approved", or "received for information" 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. Notes shall be incorporated prior to submission

of the final submittal.

c. Submittals marked "return for additional information" require the Contractor to make the necessary corrections and revisions and to re-submit them for approval in the same routine as before, prior to proceeding with any of the work depicted by the submittal.

d. Submittals marked "not approved" indicate noncompliance with the contract requirements and shall be re-submitted with appropriate changes. No item of work requiring a submittal shall be accomplished until the submittals are approved or approved as noted.

e. Contractor shall make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes" shall be given to the Contracting Officer. Approval of the submittals by the Contracting Officer shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Contractor shall be responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

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

1.5.2 Sample Approval

Furnish, for the approval of the Contracting Officer, samples required by the specifications or by the Contracting Officer. Shipping charges shall be paid by the Contractor. Materials or equipment requiring sample approval shall not be delivered to the site or used in the work until approved in writing by the Contracting Officer.

Each sample shall have a label indicating:

a. Name of project

b. Name of Contractor

c. Material or equipment

d. Place of origin

e. Name of producer and brand

f. Specification section to which samples applies

g. Samples of furnished material shall have additional markings that will identify them under the finished schedules.

Contractor shall submit to the Contracting Officer two samples of materials where samples are requested. Transmit to the Contracting

Officer with each sample a transmittal form, original and four (4) copies, containing the above information.

Approval of a sample shall be only for the characteristics or use named in such approval and shall 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. No change or substitution will be permitted after a sample has been approved.

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

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

Variations from contract requirements shall be specifically pointed out in transmittal letters. Failure to point out deviations may result in the Government requiring rejection and removal of such work at no additional cost to the Government.

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

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

1.6 PROGRESS SCHEDULE

1.6.1 Bar Chart

a. Submit four (4) copies of the progress chart, for approval by the Contracting Officer, at the Preconstruction Conference.

b. Prepare the progress chart in the form of a bar chart utilizing 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 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 task which includes punch list, clean-up and demolition, and final construction drawings.

(4) A materials bar and a separate labor bar for each line item. Both bars will show the scheduled percentage complete for any given date within the contract performance period. Labor bar will also show the number of men (man-load) expected to be working on any given date within the contract performance period.

(5) The estimated cost and percentage weight of total contract cost for each materials and labor bar on the chart.

(6) Separate line items for mobilization and drawing submittal and approval. (These items are to show no associated costs.)

d. Update the progress schedule every 30 calendar days throughout the contract performance period.

1.7 STATUS REPORT ON MATERIALS ORDERS

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

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

a. Material name, supplier, and invoice number.

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

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

d. Current delivery date agreed on by supplier.

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

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

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 35 26.98

GENERAL SAFETY REQUIREMENTS
08/13

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 REFERENCES

The documents listed below are incorporated by reference into this contract as if fully rewritten herein.

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA NPR 8621.1	NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping
NASA NPR 8715.3	NASA General Safety Program Requirements
GLM-QS-1700.1	Glenn Research Center, Safety Manual
GLM-QS-1800.1	Glenn Research Center, Occupational Health Programs Manual

1.3 SUBMITTALS

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

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, "Safety Plan" and "Protection Plan," of this section.

Site Specific Health and Safety Plan G
Protection Plan G

Construction Project Training Summary Report G

Construction Project Training Summary ReportG

Training certifications for fall protection compentent person.

Steel Erection PlanG

1.3.1 Site Specific Health and Safety Plan

Contractor shall submit a site specific safety plan to the Contracting Officer for approval within 10 working days after award of contract and it shall be approved prior to notice to proceed. Compliance to the safety plan is mandatory. A copy of this approved plan shall be maintained on the construction site..

The Site Specific Health and Safety plan shall include, as a minimum, the following:

a. Health and Safety program objectives.

b. Description of work.

c. Methods to attain safety objectives.

d. Responsibility of key personnel for the Contractor.

e. List of subcontractors and their competent persons.

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

g. Identification of safety hazards and mitigation plan to allow for safe conduct of work. If the hazard cannot be mitigated, include specific PPE that shall be worn.

h. Emergency plan including emergency number and muster locations.

i. Lists of key personnel to be contacted in times of emergency.

j. Program to show compliance with Federal OSHA Safety and Health Standards 29 CFR 1910 and 29 CFR 1926 and various safety requirements of NASA NPR 8715.3. This shall include an overall site Fall Protection Plan that demonstrates that the requirements and criteria for fall protection in construction workplaces covered under 29 CFR part 1926 will be met for every activity taking place during the project.

k. Methods to comply with the requirement for immediate reporting of mishaps to the Contracting Officer in accordance with NASA NPR 8621.1. This document is available at: http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_8621_001B_&page_na

l. 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.

m. 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.

n. Provide MSDS sheets for all chemicals which will be used. Methods for handling and storage shall be identified.

o. Identify the competent person and the competent person for specific activities as required by 29 CFR 1926.

p. The Health and Safety plan shall be reviewed and signed by all site personnel.

q. Daily documented site safety inspections shall be performed and documented.

r. A C-979 Fall Prevention Plan form shall be completed if the workers are working at a height of 6 feet or greater.

s. If the prime contractor is writing the HASP for a subcontractor, then the subcontractor shall submit documentation on company letterhead indicating that they concur with the HASP and are able to comply with all controls and personal protective equipment requirements as specified by the prime contractor.

1.3.2 Protection Plan

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

1.3.3 Construction Project Training Summary Report

The contractor shall provide a submittal of an up-to-date Construction Project Training Summary Report containing worker's names, employers, assigned tasks, qualifying training, certifications, and dates of training for a prime and subcontractor workers to be on site. The submittal shall include a statement from the prime contractor stating that the construction workers have undergone a qualifications review and verified as being qualified for assigned tasks while at the GRC construction site. The Construction Project Training Summary Report shall be updated and submitted monthly. The Construction Project Training Summary Report shall be reviewed and accepted by the Project Team through the Contracting Officer. The status of the Construction Project Training Summary Report shall be incorporated into the project meeting minutes and shall document any Project Team comments.

1.3.4 Steel Erection

Provide a steel erection plan per 29 CFR 1926.752 prior to the beginning of any steel erection operation.

1.4 SAFETY SUPERVISION

Contractor's Safety Supervisor shall ensure that:

a. NASA fall protection requirements are included in work instructions where NASA employees and/or contractors will be working in situations that require fall protection.

b. Ensure that anyone who is identified as a qualified person (per

ANSI/ASSE Z359.0-2007, paragraph 2.109) to serve as a subject matter expert in support of the Center's Fall Protection Program has been trained by an industry-recognized trainer, NASA-recognized trainer/training center, or NASA-developed training program equivalent to ANSI and OSHA compliant training (Ref: ANSI/ASSE Z359.2 -2007 Section C.5).

c. For each situation that requires fall protection, ensure that there is a competent person (per ANSI/ASSE Z359.0-2007, paragraph 2.27) assigned responsibility for the immediate application of fall protection work where fall protection is required whose education and training has been administered by an industry-recognized trainer, NASA-recognized trainer/training center, or NASA-developed training program equivalent to ANSI and OSHA compliant training. Fall protection competent person shall be on site 100% of the time active fall protection is being used.

d. Construction personnel are performing work in compliance with the approved site specific health and safety plan.

1.5 GENERAL SAFETY PROVISIONS

The GRC Safety Manual, GLM-QS-1700.1, is available online at http://smad-ext.grc.nasa.gov/shed/pub/gsm/gsm-manual.pdf.

The GRC Occupational Health Programs Manual, GLM-QS-1800.1, is available on-line at http://smad-ext.grc.nasa.gov/shed/pub/ohpm/ohpm-manual.pdf

These documents are incorporated by reference into this contract as if fully rewritten herein.

The Contractor and all subcontractors are 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.

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.

All contractor and subcontractor employees shall sign the HASP to document that they understand and will comply with the contents.

Contractor shall comply with the requirements of NASA NPR 8715.3. This document is available at http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_8715_003C_&page_name=main
The contractor shall protect workers who may be exposed to a fall of six feet or greater to a lower level for construction activities. This requirement is more stringent in some cases than that required by 29 CFR 1926, such as for steel erection.

1.6 SAFETY LOCKOUT/TAGOUT PROCEDURES

Contractor shall ensure that each employee is familiar with and complies with these procedures and 29 CFR 1910.147.

Contracting Officer will, at the Contractor's request, apply lockout/tagout red locks and 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 red lock and 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 red lock and tag unless he, his immediate supervisor, project leader, or a subordinate has in his possession the stubs of the required lockout/tagout red lock and tags.

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

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

Before clearance will be given on any equipment, the apparatus, valves, electrical circuits, or systems shall be secured in a passive condition with the appropriate vents, pins, and locks.

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

Vent valves shall be tagged and locked 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.

1.6.1 Tag Placement and Removal

Lockout/tagout red locks and tags shall be completed in accordance with the regulations in Chapter 9 of the GRC Safety Manual, GRC-MQSA.001 and attached to any device which, if operated, could cause an unsafe condition to exist.

1.7 ACCIDENT TREATMENT AND RECORDS

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

Emergency response shall require the Contractor to call 911 on a NASA phone or 216 433-8888 (LF) or 419-621-3222 (PBS)on an outside line.

1.8 FIRE PREVENTION AND PROTECTION

Open-flame heating devices will not be permitted except by approval in writing from the Authority Having Jurisdiction (AHJ) at GRC. Approval for the use of open fires and open-flame 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.

All hot work operations shall comply with NASA GRC Safety Manual, Chapter 28, Hot Work Authorization. Prior to hot work, a C-7a Hot Work Authorization Permit shall be issued by the Safety, Health and Environmental Division. Immediately prior to hot work operations, a C-7b form and associated inspection shall be completed by the responsible person.

Contractor shall discontinue burning, welding, or cutting operations 1 hour prior to the end of the normal work day. A workman shall remain at the site for 1 hour after discontinuing these operations to make thorough inspection of the area for possible sources of latent combustion. The Contractor shall be equipped with the appropriate fire extinguishers and shall be trained in the proper use of fire extinguishers. Any unsafe conditions shall be reported to SHED. (Telephone: (216) 433-2088)

1.9 ELECTRICAL

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.

1.10 UNDERGROUND UTILITIES

A Confined Space Entry Permit, NASA C-199, as per Chapter 16 of the Glenn Safety Manual is required before any Contractor personnel enters a manhole. Contractor shall contact the Contracting Officer for support services by calling (216) 433-8888 at least 72 hours in advance.

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

1.11 RADIATION SAFETY REQUIREMENTS

License Certificates for radiation materials and equipment shall be submitted by the Contracting Officer for all specialized material and equipment per Chapter 9 of the Glenn Occupational Programs Manual.

Operations performed by the Contractor which utilize nuclear density gauges shall be included in the HASP.

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.

1.12 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.

1.13 DIGGING, TRENCHING, AND/OR EXCAVATION

Prior to performing any excavation work or any surface penetrations on any ground surface, the Contractor shall obtain from the Facilities Division an Excavation Permit. The Contractor shall comply with GRC Safety Manual, Chapter 35, Digging, Trenching and Excavation Procedure. Excavations greater than 4 ft in depth may be considered to be confined spaces. As such, these shall be evaluated by SHED with regard to existing and potential hazards to determine if the excavation shall be considered a permit-required confined space. Further regulations regarding confined spaces follow:

-Below 4 and 20 ft, SHED shall evaluate and determine if an excavation is to be considered a permit-required confined space based upon the known and potential hazards.

-Below 20 ft in depth, all excavations shall be considered to be permit-required confined spaces and the requirements of the Glenn Safety Manual, Chapter 16, Confined Space Entry, shall be in effect.

Employees who work in or around excavations must be provided training according to their work activities.

1.14 GAS PROTECTION

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

Readings shall be permanently recorded daily, indicating the concentration of gas, number and location of drilled piers, point of test, date, and time of test.

All gas detection equipment shall be calibrated as per the manufacturer's requirements. Documentation of this calibration shall be made available to the Government upon request.

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. The contractor shall not enter a confined space that is oxygen deficient or may be immediately dangerous to life and health.

1.15 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.

1.16 HIGH NOISE LEVEL PROTECTION

Operations performed by the Contractor that involve the use of equipment with output of high noise levels (jackhammers, air compressors, and explosive device activated tools) shall be scheduled for after duty working hours. Use of any such equipment shall be approved in writing by the Contracting Officer prior to commencement of work.

1.17 LASER

Operations performed by the Contractor which utilize lasers shall be included in the HASP. For further requirements, see GRC Occupational Health Program Manual Chapter 13, "Laser Safety," at http://smad-ext.grc.nasa.gov/shed/pub/ohpm/ohpm13-laser.pdf .

1.18 SEVERE STORM PLAN

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

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.

1.19 CONFINED SPACE

Comply with the requirements in Chapter 16 of the GRC Safety Manual, 29 CFR 1910.146.

Prior to a permit required confined space entry, a confined space permit C-199 form shall be submitted for approval from SHED. All contractors involved with entry into or working in confined spaces shall have training in confined space entry.

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 SHED for entry procedures.) All hazards pertaining to the space shall be reviewed with each employee.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained.

c. Manholes and excavations require continuous atmosphere monitoring with audible alarm for toxic gas detection and low oxygen levels.

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

e. Entry Permit. Use C-199 , completed by the qualified person. Post the permit in a conspicuous place close to the confined space entrance.

1.20 MISHAP INVESTIGATIONS

Refer to the Glenn Safety Manual, Chapter 21. If a mishap occurs during the project that requires investigation per Chapter 21, the mishap site, which may include the entire construction work area, may be secured by NASA and not released to the Contractor for up to 75 working days. **Contractor shall not be entitled to additional payment for any expenses incurred as a result of the investigation.** Contractor shall submit a schedule recovery plan once the site is release back to the Contractor showing how the remaining work will be accomplished within the current contract period. If the Contractor determines the schedule cannot be recovered within the current contract period, a contract extension may be negotiated at no cost to the Government.

1.21 FALL PROTECTION

It is NASA's policy to provide fall protection for any walking working surface where a person is exposed to a fall to a lower level. Fall protection programs shall focus on eliminating the fall hazard before an individual is exposed to the hazard.

a. Fall protection programs shall protect workers who may be exposed to a fall six feet or greater to a lower level for all construction activities - including steel erection.

b. For work within 6 feet of an edge, on low-slope roofs, protect personnel from falling by use of personal fall arrest systems, guardrails, or safety nets. A safety monitoring system is not adequate fall protection and it not authorized.

c. "Fall hazards” from any height to lower level shall require protection if the work is over a collateral hazard (e.g. moving machinery, chemicals, electrical hazards, impalement hazards).

Competent person: For each situation that requires fall protection at GRC, there is a competent person (per ANSI/ASSE Z359.0-2007, paragraph 2.27) assigned responsibility for the immediate application of fall protection work where fall protection is required whose education and training has been administered by an industry-recognized trainer.

The fall protection competent person shall be on the construction site 100% of the time that active fall protection is being used.

Written Fall Protection Plan: specific fall protection requirements, including rescue plans, shall be developed and submitted to NASA for approval, using the C-979 Fall Prevention Plan form, as an appendix to the Health and Safety Plan.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 35 43.98

ENVIRONMENTAL PROTECTION PROCEDURES
01/13

PART 1 GENERAL

1.1 SUMMARY

The pollution prevention, environmental compliance, and sustainability provisions described in this section apply to all work under this contract.

1.2 REFERENCES

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

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

29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR 1910.1200	Hazard Communication
29 CFR 1910	Occupational Safety and Health Standards
40 CFR 82	Protection of Stratospheric Ozone
40 CFR 112	Oil Pollution Prevention
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 265.16	(2003) Personnel Training
40 CFR 273.2	(2003) Batteries
40 CFR 273.3	(2003) Pesticides
40 CFR 273.4	(2003) Mercury Thermometers
40 CFR 273.5	(2003) Lamps
40 CFR 173	(2005) Shippers -- general requirements for shipments and packagings
40 CFR 177	(2005) Carriage by public highway
40 CFR 178	(2005) Specifications for packaging
40 CFR 761	Polychlorinated Biphenyls (PCBs)

	Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
49 CFR 100-185	(2002) Transportation
49 CFR 171	General Information, Regulations, and Definitions
50 CFR 17	(2002) Endangered and Threatened Wildlife and Plants

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00.98, SUBMITTAL PROCEDURES, in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Environmental protection plan; G

Dirt and dust control plan; G

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

A copy of the Hazard Communication Written Program per 29 CFR 1910.1200(e); G.

MSDSs of all products before bringing these materials on-site; G.

List of Solid Waste, Hazardous Waste, Construction Debris (CD) and Commercial/Industrial Fill (CIF) Subcontractors four weeks prior to removal from site; G.

Treatment, Storage and Disposal Facility List: The Contractor shall submit a list of storage and disposal facilities (TSDF) that perform treatment, storage, or disposal services under this contract. Each facility shall have, as a minimum, EPA RCRA interim status or state approval as a treatment of disposal facility and be in good standing with regulatory community. Recycling facilities shall meet all federal, state and local regulations. The Contractor shall not use a facility other than those initially approved for use under this contract without first obtaining the written approval of the COTR.

SD-06 Test Reports

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

RCRA 90-Day Waste Accumulation Site Inspection Checklists, weekly for all hazardous waste storage areas for the duration of the on-site project work.

Hazardous Waste Profiles, and supporting analytical data three weeks prior to disposal for NASA GRC Waste Management (WM) to review prior to Safety, Health and Environmental Division(SHED)

signature.

Laboratory analysis

Disposal Requirements

SD-07 Certificates

TSDF Letter of Acceptance and Hazardous Waste Manifests 3 weeks prior to shipment and for review by WM and signature by NASA GRC SHED immediately prior to shipment.

Final, signed hazardous waste manifests completed by the contractor and disposal facility in accordance with 40 CFR 261. NASA GRC Waste Management shall receive the final signed manifest directly from the disposal facility. In the event the contractor receives the final signed manifest, it shall be immediately forwarded to the NASA Waste Management. For Solid Waste/CD/CIF all documents shall be forwarded to the Contracting Officer by the Contractor.

SD-11 Closeout Submittals

Some of the records listed below are also required as part of other submittals. For the "Records" submittal, maintain on-site a separate three-ring Environmental Records binder and submit at the completion of the project. Make separate parts to the binder corresponding to each of the applicable sub items listed below.

Preconstruction survey

Waste determination documentation

Disposal documentation for solid, hazardous, and regulated waste

Contractor employee training records in compliance with 40 CFR 265.16, 29 CFR 1910.120, 29 CFR 1910.1200 and 40 CFR 82.

Regulatory notification

Erosion and sediment control inspection reports

Solid waste disposal report

Contractor Hazardous Material Inventory Log

Hazardous Waste/Debris Management

Reclamation of Equipment Containing Hazardous Waste Residues: The Contractor shall submit to the COTR the facility to which equipment containing hazardous material residues are shipped for reclamation, such as electrical wrapped with asbestos and electrical panels containing asbestos. The disclosure shall be documented on the Bill of Lading or by other written means. This process shall be managed by NASA GRC WM.

Disposal of Non-Hazardous Waste Containing Hazardous Material Residue: The Contractor shall submit to the COTR the facility to which equipment containing hazardous material residues are shipped

for disposal, such as steel coated with lead paint. The disclosure shall be documented on the Bill of Lading or by other written means. Supporting analytical data shall be included to document the equipment is not hazardous waste.

1.4 GENERAL RESPONSIBILITIES

Conduct project activities in a manner that protects surface/ground water and air quality, conserves resources, and minimizes the use of toxic chemicals and hazardous materials.

Minimize environmental pollution and damage that may occur as the result of construction and demolition operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract.

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

The Contractor shall be responsible for payment of all fines/fees for violation or non-compliance with Federal, State, Regional and local environmental laws and regulations.

1.5 CONSTRUCTION AND DEMOLITION DEBRIS (C&DD) MANAGEMENT

Any removed or demolished item that meets the definition of C&DD shall be evaluated for reuse and/or recycling. The Contractor shall reuse or recycle any item that can be segregated from the waste stream and reused or recycled in a cost effective manner. NASA GRC WM manages the Construction Waste Management Program. All reuse, recycling and disposal activities shall be coordinated with the NASA GRC WM. The Contractor shall submit a manifest for any C&DD materials that will be reused off site, recycled or disposed of to the COTR, which will then be reviewed and approved by NASA GRC WM for transportation off-site. Materials that will be reused or recycled shall be segregated and manifested individually. NASA has specifically targeted the following materials for reuse or recycling: Asphalt, Concrete, Gravel/Stone, Commercial/Industrial Fill Soil, Topsoil, Trees/Bushes, Ferrous and Non-Ferrous Metals, Concrete Block, Bricks, Carpeting, and Ceramic Tiles.

1.6 DEFINITIONS

Construction and Demolition Debris - Those materials resulting from the alteration, construction, destruction, rehabilitation, or repair of any manmade physical structure, including, without limitation, houses, buildings, industrial or commercial facilities, or roadways. "Construction and demolition debris" does not include materials identified or listed as solid wastes, infectious wastes, or hazardous wastes pursuant to Chapter

3734 of the Revised Code and rules adopted under it; or materials from mining operations, nontoxic fly ash, spent nontoxic foundry sand, and slag; or reinforced or non-reinforced concrete, asphalt, building or paving brick, or building or paving stone that is stored for a period of less than two years for recycling into a usable construction material. For the purpose of this definition, "materials resulting from the alteration, construction, destruction, rehabilitation, or repair of any manmade physical structure," are those structural and functional materials comprising the structure and surrounding site improvements, such as brick, concrete and other masonry materials, stone, glass, wall coverings, plaster, drywall, framing and finishing lumber, roofing materials, plumbing fixtures, heating equipment, electrical wiring and components containing no hazardous fluids or refrigerants, insulation, affixed carpeting, asphalt substances, metals incidental to any of the above, and weathered railroad ties and utility poles. "Materials resulting from the alteration, construction, destruction, rehabilitation, or repair" do not include materials whose removal has been required prior to demolition, and materials which are otherwise contained within or exist outside the structure such as solid wastes, yard wastes, furniture, and appliances. Also excluded in all cases are liquids including containerized or bulk liquids, fuel tanks, drums and other closed or filled containers, tires, and batteries.

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

Universal Waste - Universal Waste means any of the following hazardous wastes that are subject to the universal waste requirements of 40 CFR part 273:

(1) Batteries as described in 40 CFR 273.2
(2) Pesticides as described in 40 CFR 273.3
(3) Thermostats as described in 40 CFR 273.4; and
(4) Lamps as described in 40 CFR 273.5.

1.7 NATURAL AND CULTURAL RESOURCES

The Contractor shall conduct activities in a manner that does not unnecessarily negatively impact fauna or flora, and in accordance with 50 CFR 17. The Contractor shall minimize interference with, disturbance to, and damage to all fish, wildlife, and plants including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal and plant species including their habitat in accordance with Federal, State, and local laws and regulations.

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to any human skeletal remains or burials, artifacts, shell, midden (refuse heap), bone, charcoal, or other deposits, rock or coral alignments, pavings, wall, or other constructed features, and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the

Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons form trespassing on, removing, or otherwise disturbing such resources. The Contractor may proceed with work in areas devoid of cultural resources.

1.8 WASTEWATER DISCHARGE PERMITS

In accordance with the Clean Water Act and State of Ohio regulations, a specific Incidental Sewer Discharge permit is required before discharging wastewaters to the sanitary sewer system from project activities such as excavation dewatering, cleaning operations, and decontamination water.

The Contractor shall complete and submit a Request for Incidental Sewer Discharge form to the Contracting Officer at least 7 days prior to the planned discharge of contaminated groundwater or other wastewater. The Contracting Officer will inform the GRC SHED of this request and obtain approval for discharge. The request shall include the estimated discharge volume, discharge rate, source of the wastewater and the duration of discharge. Analyses may be needed to obtain discharge approval from EMB.

1.8.1 Wastewater Discharge

With the exception of non-contaminated groundwater from an excavation, wastewater from Contractor operations shall be containerized by the Contractor until the Contractor is notified of discharge approval.

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

Non-sewerable wastewater that is hazardous waste shall be managed and disposed of properly by the Contractor. Non-sewerable waastewater that is nonhazardous waste shall be treated, managed, and disposed of properly by the Contractor.

1.9 AIR QUALITY

Construction operations and materials used on the project shall be in compliance with federal, state, and local air pollution standards, rules and regulations.

Chlorofluorocarbons (CFCs), Hydrochlorofluorocarbon (HCFC), Other Ozone Depleting Substances (ODS) and their substitutes.

Class I Ozone Depleting Substances shall not be used in the performance of this contract, nor be provided as part of the equipment without prior written permission from the Environmental Management Branch. This prohibition shall prevail over any other provision, specification, drawing, or referenced documents. A list of Class I ODS may be obtained from US EPA or their web page at http://www.epa.gov/ozone/ods.html.

Class II Ozone Depleting Substances shall not be used in the performance of this contract, nor be provided as part of the equipment

without prior written permission from the Environmental Management Branch. This prohibition shall prevail over any other provision, specification, drawing, or referenced documents. A list of Class II ODS may be obtained from US EPA or their web page at http://www.epa.gov/ozone/ods2.html.

Chemicals used in lieu of ozone depleting substances (Substitutes or alternatives) must conform with US EPA's Significant New Alternatives Policy (SNAP) program. These rules are summarized on the US EPA web page at http://www.epa.gov/ozone/snap/lists/index.html.

Service, maintain, renovate, and demolish ODS and ODS Substitute containing equipment in accordance with 40 CFR 82. The Contractor shall ensure that ODS refrigerants and their substitutes are handled by a certified technician. The recovery equipment shall meet applicable EPA requirements and be certified with US EPA.

Hazardous Air Pollutants (HAPs).

The list of specific chemicals and compounds defined as HAPs in Section 112b of the 1990 Clean Air Act Amendments is available from Ohio EPA on-line at: http://www.epa.state.oh.us/dapc/general/haplist.html. This listing is subject to change and only the currently listed items require tracking.

The use of HAPs and materials containing HAPs is allowed at GRC however the airborne release of HAPs shall be minimized at all times.

Records of the use of HAPs and materials containing HAPs must be provided to the CO for forwarding to the Environmental Management Branch. At a minimum, this should include Material Safety Data Sheets and quantities of each HAP and materials containing HAPs used.

Product and waste HAPs and materials containing HAPs must be stored in such a way as to prevent their release to the atmosphere.

Prohibition of Air Pollution Nuisances

No air pollution generating activity shall be allowed if it is expected to cause an air pollution nuisance.

No air pollution generating activity shall be allowed to continue if it is found to be an air pollution nuisance.

1.10 HAZARDOUS WASTE LIABILITY

Hazardous Waste Liability - For the purpose of this contract, the Contractor shall be responsible for any release or threatened release of the materials or substances handled under this contract, as well as any liabilities resulting or arising from or related to this contract, and shall bear all costs pertaining to such releases including, but not limited to, responses, remediation, testing, or disposal costs, and further shall defend and indemnify the Government for any costs including, but not limited to, any judgments, penalties, assessments, litigation, or attorney fees.

1.11 HAZARDOUS WASTE TRANSPORTATION

Certified Waste Haulers shall be utilized. Government directed waste shall be transported to the disposal facility or interim storage facility without delay, in accordance with Department of Transportation (DOT) manifest regulations. The Contractor shall notify the Government if 10 days or more have a elapsed during shipment.

1.12 SUSTAINABILITY

The Contractor shall conduct its activities in a manner that conserves resources and minimizes pollution in accordance with Executive Order 13101 "Greening the Government Through Waste Prevention, Recycling and Federal Acquisition" and Executive Order 13123 "Greening the Government Through Efficient Energy Management".

Minimize the amount of energy required during construction and operation by using resource efficient construction techniques, building systems (including HVAC, heating, electrical, water, lighting, heat-pumps and boilers), insulation, fixtures, appliances, and controls.

Whenever possible, utilize energy efficient office equipment through the Environmental Protection Agency's Energy Star labeling program (@ http://www.epa.gov/energystar/).

Use automated monitors and controls for energy, water, waste, temperature, moisture, and ventilation.

Conserve water with systems that reduce consumption and recycle water through reclamation and treatment systems.

Maximize the reduction, reuse, recycling or composting of waste and scrap materials.

Minimize waste, spillage, pilferage, spoil, and misuse of building materials.

Follow federal Comprehensive Procurement Guidelines (@ http://www.epa.gov/epaoswer/non-hw/procure/) for building materials and products, and select materials that have a long-life cycle; select least toxic materials; select recyclable materials; select materials that are resource-efficient; select materials with the maximum recycled content; select materials harvested on a sustained yield basis; select products causing the least pollution during their manufacture, use and reuse.

1.13 TRAINING REQUIREMENTS

Personnel handling hazardous materials shall have received Hazard Communication Training per 29 CFR 1910.1200(h), and personnel handling hazardous waste shall have received appropriate DOT and Hazardous Waste and Emergency Response Operations (HAZWOPER) Emergency Response Awareness Level Training per 29 CFR 1910.120. Employee training documents shall be kept at the jobsite.

Personnel containing spills or conducting cleanup of small spills shall have received First Responder Operators level training per 29 CFR 1910.120. (Note: Personnel with First Responder Operators level training can contain

a spill to stop its spread from a safe distance. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures.

Personnel generating hazardous waste shall have receive training on the proper management of hazardous waste per 40 CFR 265.16.

Personnel Handling Refrigerants shall have training in accordance with 40 CFR 82.

1.14 CHEMICAL USGAE, STORAGE, AND HANDLING

Hazardous material shall be used only as described on the Material Safety Data Sheet and/or Contractor's written instructions. The Contractor shall wear the protective equipment recommended by the manufacturer of the hazardous material. Containers of hazardous materials and hazardous wastes shall be kept closed except when in use. Containers of liquid hazardous materials shall be stored in secondary containment at the end of each work shift.

1.14.1 Hazardous Materials Storage

Hazardous materials storage shall be in accordance with Federal, State, and local regulations, and the General Storm Water Permit. Hazardous materials shall be handled in a manner that minimizes the potential for releases. All liquid hazardous materials must be secondarily contained. Adequate spill response equipment shall be readily available.

Hazardous materials and hazardous wastes shall be labeled, handled properly, and stored in secondary containment at the end of each work day. Secondary containment shall be of adequate size and compatible with the materials stored. Storage areas shall be properly labeled and secured. Storage areas shall be in accordance with Section 01 57 23.98, Storm Water Pollution Prevention.

At the beginning of the project, an accurate inventory of hazardous materials and hazardous wastes to be generated including the estimated maximum quantity of each hazardous material to be brought on-site shall be provided to the COTR. Material Safety Data Sheets (MSDSs) for hazardous materials shall be maintained by the Contractor so they are immediately available to assist emergency response personnel in the event of a hazardous materials incident. Copies of the MSDSs shall be provided in the Health and Safety Plan (HASP).

1.14.2 Refuse Bins

Refuse bins shall not be overloaded. Liquid materials shall not be placed in dumpsters or bins. Leaking dumpsters shall be replaced. Dumpsters and bins shall not be cleaned on-site. Dumpsters shall remain covered except when actively being loaded.

1.14.3 Site Inspections

The project site and storage areas shall be inspected weekly to ensure compliance. Compliance status shall be verified by the Contractor. The checklists shall be submitted to the COTR, within 48 hours following the inspection.

1.14.4 Labeling

Containers, drums, vessels, tanks, and associated piping containing hazardous materials shall be labeled in accordance with 29 CFR 1910.1200 (f).

Hazardous material labels must have a description of the contents (including percentages of components for compounds), an appropriate hazard warning and the name and address of the manufacturer or other responsible party.

Hazardous waste and solid waste containers shall be appropriately marked, pending analysis, in accordance with 40 CFR 262 with, at a minimum, accumulation start date and contents and documented during weekly inspections.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 SITE OPERATIONS AND MAINTENANCE

Site Operations shall be conducted in accordance with the Clean Water Act and GRC Storm Water Pollution Prevention Plan. For projects over 1 acre (total) in size, a Storm Water Pollution Prevention Plan must be submitted to the GRC SHED 2 months prior to project commencement for review and approval. (See Storm Water Pollution Prevention Section 01 57 23.98.)

Equipment Fueling and Maintenance - Equipment fluid changes and fueling shall be conducted over drip pans to prevent spilled materials from contacting the ground surface. The operator of leaking equipment shall contain and control the leak. The Contractor shall contact NASA GRC Waste Management through the Contracting Officer to coordinate proper disposal of waste materials generated during equipment maintenance.

3.1.1 Paint Clean-up

Painting operations must be conducted in accordance with GRC Storm Water Pollution Prevention Plan and applicable State of Ohio requirements.

Water Based Paints:

The Contractor shall paint out as much excess paint as possible from brushes, rollers, and equipment before starting clean up. Rinse brushes, rollers, and other tools over a sink that drains to the sanitary sewer using water only. Tools and equipment shall not be cleaned into streets, gutters, storm drains, or creeks. Dispose of dry brushes, rollers, rags, and drop cloths as solid waste.

Disposal of containers with any liquids as a solid waste is prohibited. These materials must be used elsewhere or handled as a regulated waste and disposed of in accordance with paragraph entitled Contractor Disposal. All empty paint containers and surplus paint shall be turned over to the government via a NASA C260A form along with the product's MSDS.

Oil Based Paints:

The Contractor shall paint out as much excess paint as possible from brushes, rollers, and equipment before starting clean up. Cleaning solutions shall be containerized and disposed of as hazardous waste. Reuse thinners and solvents by pouring back into original container through a filter.

Dispose of waste thinners, solvents, paint sludge, and solutions from cleaning of equipment and tools as hazardous waste. Containers with residual product shall be managed as a hazardous waste and disposed of. All empty paint containers and surplus paint shall be turned over to the government via a NASA C260A form along with the product's MSDS.

3.1.2 Concrete/Asphalt Cutting and Core Drilling

The Contractor shall prevent not allow slurry run-off from saw cutting or core drilling to enter the storm or sanitary sewer collection systems. Catch basins and drains shall be protected.

3.1.3 Sweeping

Roadways and on-site paved areas impacted by the project shall be cleaned to the satisfaction of the COTR and swept at the end of each phase or at project completion. Hosing down paved areas and streets is prohibited.

3.1.4 Sewage Sludge

Sewage Sludge and Compost Materials containing human waste is prohibited from use at GRC.

3.1.5 Draining, Tanks, Piping, and Equipment

Tanks, piping, and equipment shall be drained as required. Devices to properly contain the product shall be provided by the Contractor. Storm drains in the vicinity shall be covered during drainage operations.

The Government will obtain the necessary sanitary sewer discharge permits if the discharge is sewerable. Non-sewerable water shall be treated to a level to allow discharge to the sanitary sewer or managed and disposed of properly by the Government.

3.1.6 Monitoring Wells

Monitoring Wells shall not be disturbed for any reason. If they are disturbed, inadvertently or not, the contractor shall incur all costs associated with the abandonment (i.e. removal) of the well in accordance with Ohio EPA requirements.

3.2 CONTAMINATED SOIL MANAGEMENT

The Contractor shall immediately stop work and notify the COTR if soil appears discolored or has an odor different from what is expected.

3.3 PCBs/PCB CONTAMINATED EQUIPMENT

All PCB-contaminated material shall be handled in accordance with 40 CFR 761.

The Contractor shall dial 911 from any NASA phone or 216-433-8888 from an

outside phone to inform Emergency Dispatch of any spills or leaks of PCB-contaminated material.

The contractor shall notify the Contracting Officer of any PCB-contaminated material that needs disposal.

3.4 SPILL PREVENTION, CONTROL AND REPORTING

All liquid petroleum products must be secondarily contained in accordance with Annex Q of GRC's Emergency Preparedness Plan and 40 CFR 112. Spill clean-up materials (such as rags, absorbent booms/pads), and tools (such as shovels and brooms) shall be maintained at the project site and be readily accessible. Releases of hazardous materials to the environment shall be contained and measures implemented to prevent leaks and spills from entering storm drains.

Dial 911 from any NASA phone or 216-433-8888 from an outside phone to inform Emergency Dispatch of any spills or leaks

3.5 HAZARDOUS WASTE DISPOSAL

The Contractor shall label, package, and secondarily contain hazardous waste in accordance with 49 CFR 171, 40 CFR 173, 40 CFR 177, and 40 CFR 178.

Storage of hazardous waste shall not exceed 90 days from the date of generation in accordance with 40 CFR 262. Hazardous waste shall be shipped for disposal no later than 90 days from the date of generation/accumulation start date.

No hazardous material or waste shall remain at the worksite upon completion of the project unless specified otherwise.

3.5.1 Hazardous Waste Manifest

NASA Glenn Research Center shall be designated as the generator on the manifest and only approved GRC Environmental Management Branch personnel shall sign any shipping documents, including Uniform Hazardous Waste Manifests.

NASA Glenn Research Center SHED shall be designated as the emergency contact.

The Contractor shall perform transportation services in compliance with 49 CFR 100-185.

The Contractor shall use only disposal facilities that have a valid permit to manage hazardous waste, and shall be responsible for determining that permit allows for the type of management and disposal intended for that waste. The Contractor shall be responsible for ensuring that any party handling hazardous waste, including subcontractors, transporters, and TSDF Letter of Acceptance and Hazardous Waste Manifests are in compliance with applicable federal, state, and local regulations. GRC EMB shall have final approval of TSDFs.

3.5.2 Containerized Hazardous Waste

Hazardous wastes and other materials shipped by the Contractor with wastes from other facilities shall not be commingled.

3.5.3 Bulk Hazardous Waste

Bulk hazardous waste shipments shall be weighed to confirm shipping weight.

3.5.4 Miscellaneous Hazardous Waste

Fluorescent light tubes, mercury containing items (batteries, emergency and exit lights) and PCB lighting ballasts and thermostats shall be turned over to the Government for recycling.

-- End of Section --

SECTION 01 42 00.98

REFERENCES
08/12

PART 1 GENERAL

.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.

Reference publications are cited in other sections of the specifications along with identification of their sponsoring organizations. The addresses of the sponsoring organizations are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

-- End of Section --

SECTION 01 45 00.98

QUALITY CONTROL
12/12

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 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00.98 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Contractor shall submit the following items in accordance with the paragraph entitled, "Records," of this section.

Quality Control Data
Quality Control Coordinating Actions
Quality Control Training
Inspection Records
Letters of Authority or Delegation
Field Tests
Factory Tests

SD-07 Certificates

Contractor shall submit a detailed written statement describing procedures that will be implemented to achieve quality on the project according to the paragraph entitled, "Quality Assurance (QA) Plan," of this section.

Contractor shall submit the following in accordance with the paragraph entitled, "Qualifications," of this section.

Contractor's Quality Representative Qualifications
Special Certifications

1.2.1 Quality Assurance (QA) Plan

QA plan shall address the following:

Description of the authority, responsibilities and coordinating procedures, of on-site/off-site quality assurance personnel, including those QA personnel not under direct control of the Contractor.

QA plan shall list personnel designated by the Contractor to accomplish the work required by the contract.

QA plan shall also contain an appendix with a copy of each form, report format, or similar record to be used in the QA program.

Contractor's organization that handles construction contract activities.

Contractor's operational plan for accomplishing and reviewing work controls, fabrication controls, certifications, and documentation of quality control operations, inspections, and test records, including those for subcontractors.

These provisions shall include the methods to be used during the procurement cycle (order to delivery) for those materials or equipment that require source inspections, shop fabrications, or similar operations located separately from the work site.

Description of on-site personnel training.

Certification(s) of personnel, procedures, processes, and equipment.

Nondestructive testing requirements.

Identification of independent certifying and testing laboratories.

1.2.2 Records

Records shall include all quality control data; factory tests or manufacturer's certifications, quality control coordinating actions; records of quality control training/certifications as well as routine hydrostatic, electrical continuity, grounding, welding, line cleaning, field tests and similar tests. Quality records shall be available for examination by the Contracting Officer.

Legible copies of the test and inspection records shall be furnished to the Contracting Officer. Records shall cover work placement traceable to the contract schedule, specifications and drawings, and shall be verified by the Contractor.

Contractor shall submit for approval, the narrative description of an inspection system which provides for compliance with the quality requirements and technical criteria of the contract within 7 calendar days after notice to proceed.

Contractor shall submit a monthly performance report that summarizes the quality operations. This report shall identify inspections made, tests performed, nonconformances, corrective actions taken, status of plans/procedures being developed, and status of open items/problems in work.

Contractor shall submit Letters of Authority or Delegation outlining the authority and responsibilities of quality control personnel along with a copy of the letter of delegation to the Contracting Officer that defines delegated duties and responsibilities.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

Contractor's Quality Representative Qualifications shall be submitted to the Contracting Officer for approval. Quality Representative may be assigned to more than one contract provided that the assigned contracts are located at the same site.

When approval or certification of special processes, operating personnel, and special equipment or procedures is required by the specifications, the Contractor shall obtain necessary approvals or special certifications prior to starting the work.

1.3.2 Quality Control Requirements

Contractor shall provide a quality control program encompassing: selection of construction materials and sources; suppliers; subcontractors; on-site and off-site fabrication of Contractor-furnished assemblies; on-site and off-site assembly; erection; work procedures; workmanship; inspection; and testing.

Contractor's program shall provide document systems ensuring that quality provisions of contract schedule, specifications, and drawings have been performed.

1.3.2.1 Management and Organization

The Quality Program Manager shall report to the Contractor's management and shall have the necessary authority to discharge contractual responsibilities.

1.3.2.2 Identification and Data Retrieval

Contractor shall have an identification and data retrieval system.

Records, drawings, submittals, and equipment shall be identified by referencing the Contract Number; Contract Specification Number; Contract Drawing Number; Submittal Document Number; Contract Change Number; and the Contractor's Drawing Number System.

1.3.2.3 Procurement

Contractor shall be responsible for controlling procurement sources and those of his subcontractors to ensure that each purchase meets quality requirements.

1.3.2.4 Receiving Inspection System

Contractor shall maintain a site receiving inspection system that ensures procured materials and equipment are inspected and tested.

Receiving inspection records shall accompany each procurement delivery to the construction site. Records of site receiving inspections shall be maintained by the Contractor.

Records shall show defects, discrepancies, dispositions, and waivers, including evidence of Government source inspection.

1.3.2.5 Nonconforming Articles and Material Control

The Contractor shall control nonconformances discovered by the Contractor, subcontractors, suppliers or Government quality representatives to prevent their use and to correct deficient operations.

a. Contractor shall prepare a "nonconformance" report for each instance comprising:

(1) A unique and traceable number.

(2) Identification of the nonconforming article or material.

(3) A description of the nonconformance and the applicable requirement.

(4) Cause or reason for the nonconformance.

(5) Remedial actions taken or recommended.

(6) Disposition of the nonconforming article or material.

b. The Contractor shall identify and mark each nonconforming article for removal from the work area.

c. The Contractor shall monitor and correct deficient operations.

1.3.2.6 Fabrication, Process, and Work Control

Contractor's procedures and controls shall ensure compliance with requirements in contract specifications and drawings.

Contractor shall establish in-process inspections, to ensure compliance with quality requirements.

1.3.2.7 Quality Control Records

Quality control records shall be maintained at a central on-site location.

Maintenance of quality control records shall not relieve the Contractor from submitting samples, test data, detail drawings, material certificates, or other information required by each section in the specification.

Contractor shall ensure each record is identified and traceable to specific requirements in the specifications and drawings.

1.3.2.8 Drawings and Change Control

Drawing-control system shall be maintained to provide revised drawings and ensure continuous removal of obsolete drawings from work areas. Changes involving interface with other work areas, or affecting materials controlled by others shall be controlled by the Contractor. This system shall be integrated with the document requirements of the contract.

Drawing changes shall be clearly annotated. Implemented changes shall be clearly identified and associated drawings shall be revised accordingly. Drawings that have been approved, or approved as noted, by the Contracting Officer shall be used for fabrication and inspection.

1.3.3 Quality Inspections

1.3.3.1 Government Inspections

Work performed under this contract will be subject to inspection by the Contracting Officer. Changes to the specifications or drawings will not be allowed without written authorization of the Contracting Officer.

When the Contracting Officer determines that inspected work needs to be corrected, the Contracting Officer will be allowed 24hours to complete reinspection of the corrected work.

Contracting Officer shall be notified before backfilling or encasing any underground utility so that work may be inspected. Failure to notify the Contracting Officer before backfill or encasement occurs shall require the work be uncovered at no additional cost to the Government.

Contractor's program is subject to continuous evaluation, review, and verification by the Contracting Officer. Contractor will be notified in writing of any noncompliance and will be given 2 calendar days to correct identified deficiencies.

1.3.3.2 Contractor's Quality Inspections

Contractor shall implement an inspection system. Documentation shall indicate quality control through records of inspections, tests, and procedures.

Contractor's quality assurance system shall include the following:

a. Contractor's representative responsible for on-site communication and operation of the inspection program.

b. Purchasing control system documenting project procurement to drawings, specifications, and approved submittals.

c. Receiving inspection system documenting inspections for each procurement.

d. Documentation for handling and disposing of nonconforming components and materials.

e. Inspection records for each specific section of the specification and drawings.

f. Identification of test(s) to be performed, test procedures, records, and independent organizations used.

g. Documenting and maintaining certification or re-certification of procedures.

h. Management of government-furnished equipment, components, and materials.

i. Calibration of gages, tools, measuring instruments, and independent laboratories used.

Contractor shall establish a system of scheduled or random audits to ensure task completion.

1.3.4 Field Services

1.3.4.1 Responsibility for Inspection and Testing

Contractor shall be responsible for all inspections and tests, and the accompanying documentation for each inspection and test. Contractor may

utilize independent inspection and testing laboratories or services as approved by the Contracting Officer.

Contractor shall also be responsible for tests of construction materials utilizing the services of an approved independent testing laboratory.

1.3.4.2 Inspection and Test Records

Contractor shall provide on-site records of each inspection and test performed throughout the life of the contract. Records shall include, but not be limited to, factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved, identification of operators and inspectors, result of inspections or tests, nature of defects, causes for rejection, proposed remedial action, and corrective actions taken.

Inspection records, test procedures, test results, and associated forms be verified by and provided to the Contracting Officer. Final test data shall have a cover letter/sheet clearly marked with the system name, date, and the words "Final Test Data".

1.4 HANDLING AND STORAGE

Contractor shall provide controls, procedures and documentation with each shipment, that meet requirements of each section of the specifications.

The Contractor shall include documentation with each shipment. The data shall consist of documentation required by the contract along with specifications required to identify, store, preserve, operate, and maintain the items shipped.

1.5 SEQUENCING AND SCHEDULING

Contractor shall notify the Government at least 72 hours prior to scheduled inspections and tests.

Contractor shall provide 72 hour notice to the Government of the date when the contract work will begin at the site.

When Contractor suspends work for 1 calendar days or longer prior to completion, the Contracting Officer shall be notified. Work shall not resume without notification of the Contracting Officer.

Contracting Officer shall be notified at least 48 hours in advance of backfilling or encasing any underground utility.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 50 00.98

TEMPORARY FACILITIES AND CONTROLS
12/12

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.

FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(Rev H; Change 1 - 2) Obstruction Marking and Lighting

1.3 SUBMITTALS

Not Used

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 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.

Contractor shall 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 shall comply with FAA AC 70/7460-1. Lights shall be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer.

3.1.1 Electricity

Contractor shall provide connections, sized to provide service required for power and lighting. Feeder and branch wiring with area distribution boxes shall be located so that power is available throughout the project site by use of power cords. 120/208 electrical volt feeder service is available. Lighting shall be provided by the Contractor. Electricity used will be furnished by the Government.

3.1.2 Water

Contractor shall make connections to existing facilities to provide water for construction purposes. Water used will be furnished by the Government, where available. Hose connections shall be fitted with anti-syphon devices. No water of any type or process shall be discharged to the storm sewer system without approval of the Contracting Officer. Water is for construction purposes only. No water is supplied for work trailers or sanitary facilities.

3.1.3 Telephone Service

No phone service is/nor will be made available. It is common at this project site to utilize cell phones. Contractor cell phones will be at the expense of the Contractor.

3.1.4 Sanitary Facilities

Contractor shall provide temporary sanitary facilities and shall service, clean, and maintain these facilities and enclosures. Temporary facilities shall be removed from the site at the completion of the work.

3.2 SIGNS

3.2.1 Other Signs and Advertisements

Only signs necessary to expedite deliveries, maintain traffic flow, promote safety (e.g. caution, danger, blasting, hardhat area), and prevent interference with Government operations shall be erected.

3.3 TRAFFIC PROVISIONS

3.3.1 Maintenance of Traffic

Contractor shall conduct his operations in a manner that will not close any thoroughfare or interfere in any way with traffic on railways or highways except with written permission of the Contracting Officer. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.

Work shall be conducted so as to minimize obstruction of traffic, and traffic shall be maintained on at least half of the roadway width at all times. Approval shall be obtained from the Contracting Officer prior to starting any activity that will obstruct traffic.

Contractor shall provide, erect, and maintain, at his own expense, lights, barriers, signals, passageways, detours, etc., that may be required.

No sidewalks shall be closed without approval by the government and a five (5) day notice.

3.3.2 Rush Hour Restrictions

Contractor shall not interfere with the peak traffic flows preceding and during normal operations without notification to and approval by the Contracting Officer.

3.3.3 Dust Control

Contractor's dust control methods and procedures shall be approved by the Contracting Officer. Dust abatement on access roads shall be treated with applications of calcium chloride, water sprinklers, or similar methods or treatment.

Dust control within occupied buildings (including construction workers) shall be reviewed with NASA's Industrial Hygiene Personnel to ensure employee health and future building cleanliness standards.

3.4 WASTE MANAGEMENT

3.4.1 Refuse Bins

Refuse bins shall not be overloaded. Liquid materials shall not be placed in dumpsters or bins. Leaking dumpsters shall be replaced. Dumpsters and bins shall not be cleaned on-site. Dumpsters shall remain covered except when actively being loaded.

3.5 PROTECTION OF EXISTING SYSTEMS

3.5.1 Utility

Connection to existing utilities, identified on the drawings to the Contractor, shall be protected from damage during construction activity.

3.5.2 Safety

Contractor shall protect the integrity of any installed safety systems or personnel safety devices.

If entrance into systems serving safety devices is required, the Contractor shall 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, the Contractor shall provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and shall obtain prior approval from the Contracting Officer.

-- End of Section --

SECTION 01 60 00.98

PRODUCT REQUIREMENTS
12/12

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

Not Used

1.3 SHIPMENT AND PROTECTION OF MATERIAL AND EQUIPMENT

Shipments shall be addressed to the Contractor who shall be responsible for their receipt, unloading, handling, and storage at the site. Government will not accept deliveries on behalf of the Contractor or his subcontractors or assume responsibility for security of materials, equipment, or supplies delivered to the site.

Deliveries shall not be addressed to or made to NASA shipping and receiving facilities. Deliveries shall be made directly to the construction site for receipt by the Contractor.

Contractor shall protect and preserve materials, supplies, and equipment of every description (including property which may be Government-furnished or -owned) and work performed.

1.4 STORAGE AND PROTECTION OF MATERIAL

1.4.1 Salvage Material

Material to be salvaged and reinstalled by the Contractor shall be protected during removal and stored to prevent damage.

1.4.2 New Material and Construction Equipment

Only material and construction equipment designated for performance of contract work may be stored at the construction site or located in Government-controlled warehouses or shop facilities.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment to be provided under this contract shall be standard catalogue products of manufacturers regularly engaged in the manufacture of the products. All material "cut sheets" and factory acceptance test data shall be provided to the Contracting Officer.

Material and equipment shall be installed in accordance with the requirements of the contract drawings , contract specifications and referenced standards and specifications.

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 62 35

RECYCLED / RECOVERED MATERIALS

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 within the text by the basic designation only.

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

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. Make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

1.3 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials. These items, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

1.4 EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

1.5 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

Many products listed in 40 CFR 247 have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

PART 2 TITLE

Not Used

PART 3 TITLE

Not Used

-- End of Section --

SECTION 01 74 19

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT
01/07

PART 1 GENERAL

1.1 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 25 percent by weight of total project solid waste shall be diverted from the landfill.

1.2 MANAGEMENT

Develop and implement a waste management program. Take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. The Environmental Manager, as specified in Section 01 35 40.00 20 Environmental Management, shall be responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the project. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor is responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained 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.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] 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

1.4 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 00.00 2001 45 00.00 10 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 site meetings.

d. Work safety meetings.

1.5 WASTE MANAGEMENT PLAN

A waste management plan shall be submitted within 15 days after notice to proceed and not less than 10 days before the 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.

1.6 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Quantities may be measured by weight or by volume, but must be consistent throughout. List each type of waste separately noting the disposal or diversion date. Identify the landfill, recycling center, waste processor, or other organization used to process or receive the solid waste. Provide explanations for any waste not recycled or reused. With each application for payment, submit updated documentation for solid waste disposal and diversion, and submit manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. The records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction.

1.7 REPORTS

Provide quarterly reports and a final report to NASA QA. Quarterly and final reports shall include project name, information for waste generated this quarter, and cumulative totals for the project. Each report shall include supporting documentation to include manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material.

1.8 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and

salvageable waste products in a manner that maximizes recyclability and salvagability of identified materials. Provide the necessary containers, bins and storage areas to facilitate effective waste management and clearly and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations. Separate materials by one of the following methods:

1.8.1 Source Separated Method.

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

a. Land clearing debris.

b. Asphalt.

c. Concrete and masonry.

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

    (1) Ferrous.

    (2) Non-ferrous.

e. Wood (nails and staples allowed).

f. Debris.

g. Glass (colored glass allowed).

h. Paper.

    (1) Bond.

    (2) Newsprint.

    (3) Cardboard and paper packaging materials.

i. Plastic.

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

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

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

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

(5) Type 5: Polypropylene (PP).

(6) Type 6: Polystyrene (PS).

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

j. Gypsum.

k. Non-hazardous paint and paint cans.

l. Carpet.

m. Ceiling tiles.

n. Insulation.

o. Beverage containers.

1.8.2 Co-Mingled Method.

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

1.8.3 Other Methods.

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

1.9 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:

1.9.1 Reuse.

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

1.9.2 Recycle.

Waste materials not suitable for reuse, but having value as being

recyclable, shall be made available for recycling. All fluorescent lamps, HID lamps, and mercury-containing thermostats removed from the site shall be recycled. Arrange for timely pickups from the site or deliveries to recycling facilities in order to prevent contamination of recyclable materials.

[1.9.3 Compost

Consider composting on site if a reasonable amount of compostable material will be available. Compostable materials include plant material, sawdust, and certain food scraps.

]1.9.4 Waste.

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

1.9.5 Return

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

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

SECTION 01 75 00.98

STARTING AND ADJUSTING
12/12

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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00.98 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Test reports shall be submitted in accordance with the paragraphs entitled, "Factory Tests", "Functional Test" and "Final Acceptance Test," of this section.

Test procedures and the recording forms shall be submitted according to paragraph entitled, "Test Procedures."

1.2.1 Tests Required

Tests shall be performed to verify proper functioning of all new equipment and other assemblies and components that need to be tested as an interrelated whole.

1.2.2 Factory Tests

Tests shall be 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.

1.2.3 Functional Test

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 system has performed per other sections and referenced industry standards.

1.2.4 Final Acceptance Test

Contractor shall perform a formal test with full documentation using the approved recording form, if applicable. Contracting Officer will witness this test and issue a written final acceptance. Final test data shall be provided to the Contracting Officer.

1.2.5 Test Procedures

Test procedure and recording forms that document the test steps shall be submitted for approval to the Contracting Officer 21 calender days prior

to the proposed test date. Procedure shall consist of 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 00.98

CLOSEOUT SUBMITTALS
12/12

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 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00.98 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

The following shall be submitted in accordance with paragraph entitled, "General," of this section.

Reproducible Drawings
CAD System Drawings

SD-02 Shop Drawings

As-Built Drawings shall be submitted in accordance with paragraph entitled, "General," of this section.

SD-03 Product Data

Spare Parts Data shall indicate manufacturer's name, part number, serial number, nomenclature, and stock level recommended for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

SD-07 Certificates

A Work Plan shall be submitted in accordance with paragraph entitled, "General," of this section.

SD-08 Manufacturer's Instructions

The following shall be submitted in accordance with paragraph entitled, "General," of this section.

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

PT&I schedule shall 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. Each test feature; e.g., gpm, rpm, psi, shall have a signoff blank for the Contractor and Contracting

Officer. A remarks column of the testing validation procedure shall include references to operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Procedures for preventative maintenance, condition monitoring (predictive testing) and inspection, adjustment, lubrication and cleaning necessary to prevent failure shall be delineated.

Posted Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section. Equipment data sheets will be included for each piece of equipment purchased and/or installed, with specific model numbers, serial numbers and optional equipment or features listed.

An equipment DATA Sheet (MADS shall be provided electronically by the Government on an Excel Worksheet. Sheet #1 shall be completed (exception will be cells colored gray) by the Contractor. The vendor shall listed on this sheet shall be the Prime Contractor. The warranty start date shall be in accordance with Section 01 78 00.98.

The remaining tabs in the Excel Worksheet shall be completed for all new equipment that has been installed under this contract. If a row within the tab does not apply, N/A for Non-Applicable shall be inserted.

The worksheet shall be typed and submitted within 15 calendar days after completion so that the Governement can electronically transfer this data to the MAXIMO program.

All O&M data shall be submitted on CD in a Adobe Acrobat version 9.0 or greater, PDF Format. The COTR will provide the Contractor with a structured file format for the purposes of archiving PDF files on the CD, indexed and arranged by specification section order.

1.3 GENERAL

Copies of drawings and CAD System Drawings shall be submitted as follows:

Three (3) copy(s) of each drawing, product data record, or log, and CAD system CD showing each drawing, product data record, or log shall be submitted for historical record.

Final drawings shall incorporate contract changes and plan deviations. Lines, letters, and details will be sharp, clear, and legible. Additions or corrections to the drawings will be drawn to the scale of the original drawing. One copy, marked with review notations by the Contracting Officer, will be returned to the Contractor. Drawings are to be resubmitted within 30 calendar days after the completion of the representative work effort.

Documents shall be current. Contractor shall not conceal record

information until as-built drawings have been made. Record drawings shall be submitted with a transmittal letter containing date, project title, Contractor's name and address, document list, and Contractor's signature.

As-Built Drawings shall be submitted under the following criteria:

In order to minimize the time for final payment at the completion of the project, the Contractor shall update the as-built drawings every month with the Contracting Officer's authorized representative. This update will be a part of "the monthly request for payment meeting," and a portion of the payment, including final payment may be withheld until the as-built drawings have been updated, and accepted by the Contracting Officer.

After completion of all construction and before final payment is made under this contract, the Contractor shall provide the Contracting Officer with one complete set of full size contract drawings with alterations shown in red pencil.

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

Schedule shall 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. Each test feature; e.g., gpm, rpm, psi, shall have a signoff blank for the Contractor and Contracting Officer. A remarks column of the testing validation procedure shall include references to operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Procedures for preventative maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair shall be delineated.

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

A Work Plan shall be submitted to the Contracting Officer for project closeout. Plan shall include all scheduled inspections, instruction classes, items, closeout dates for all functions, and shall list the required Government and Contractor personnel that will be taking part in these functions.

Posted Instructions shall be submitted by the Contractor with labels, signs, and templates of operating instructions that are required to be mounted or installed on or near the product for normal, safe operation.

Contractor shall submit four (4) copies of the project operation and maintenance manuals 30 days prior to testing the system involved. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

Spare Parts Data shall 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.

1.4 WARRANTY OF CONSTRUCTION

In accordance with FAR clause 52.246-12 the Contractor shall provide a 1-year warranty from "acceptance of the work". NASA Glenn Research Center interprets this as 1-year from the final acceptance date. Subcontracts or Supply Purchase Orders shall include these provisions. The following clarifications are made to assure complete understanding of warranty provisions:

The prime Contractor shall operate and maintain all equipment and systems installed until the contract final acceptance date. This includes maintenance service inspections, filter replacements and other work as recommended by the manufacturer. Following final acceptance, the Government will assume O&M responsibilities in accordance with the manufacturer's recommendations.

The prime Contractor shall provide a written 1 -year warranty from the contract final acceptance date to the Government covering all materials, labor and workmanship. Warranty repairs may require the services of subcontractors or suppliers, but shall be managed and coordinated by the prime.

The prime Contractor shall provide a 1-year certificate of warranty from each supplier or provider for all purchased equipment or systems. Requests for warranty repairs shall be made will be made directly to the manufacturer or supplier.

This provision is not affected by the Government's beneficial use or occupancy prior to the final completion. The warranty date may be adjusted throughout the course of his contract as required to include contract time extensions with an equitable adjustment to the contract. Should the contractor complete the work ahead of schedule, the warranty provisions will be revised to reflect the actual completion.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 OPERATION AND MAINTENANCE

Operation and Maintenance Manuals shall be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. All O&M data shall be submitted on a CD in a Adobe Acrobat version 9 or higher PDF format. The COTR will provide the Contractor with a structured file format for the purposed archiving PDF files on the CD.

Contractor shall submit classroom and field instructions in the operation and maintenance of systems equipment where required by the technical provisions. These services shall be directed by the Contractor, using the

manufacturer's factory-trained personnel or qualified representatives. Contracting Officer shall be given 7 days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor, such as lists, static exhibits, and visual aids, shall be made available to the Contracting Officer. Contractor shall video record training sessions and submit the recordings in CD or DVD format.

-- End of Section --

SECTION 02 41 00.98

DEMOLITION
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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 145	(1991; R 2003) Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
AASHTO T 180	(2001) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

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

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00.98 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor shall record Existing Conditions prior to starting work in accordance with the paragraph entitled, "Existing Conditions," of this section.

Interruption of the following shall be submitted:

Utility Outages
Traffic Interruptions

SD-07 Certificates

Contractor shall submit a detailed Demolition Plan of the work procedures and safety precautions to be used prior to the beginning of work.

1.3 DEMOLITION PLAN

Contractor shall prepare and submit a detailed Demolition Plan of the work procedures and safety precautions to be used in the identification, demolition, handling, removal, transportation, and reclamation or disposal of removed materials. Contractor shall meet with the Contracting Officer,

prior to beginning work, to discuss in detail the demolition plan.

1.4 EXISTING CONDITIONS

Existing Conditions shall be recorded in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Such record shall contain 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 the start of work. Copies of the record shall be submitted and the stated conditions before starting work shall be verified.

1.5 INTERRUPTION OF SERVICE

Written approval by the Contracting Officer for interruption of service Utility Outages and Traffic Interruptions shall be submitted at least [48] 72 hours prior to work.

PART 2 PRODUCTS

2.1 FILL MATERIAL

Fill material shall conform to the definition of satisfactory soil material as defined in AASHTO M 145, Soil Classification Groups A-1, A-2-4, A-2-5 and A-3. In addition, fill material shall be free from roots and other organic matter, trash, debris, frozen materials, and stones larger than 2 inches in any dimension.

Proposed fill material shall be sampled and tested by an approved soil testing laboratory, as follows:

Soil classification	AASHTO M 145
Moisture-density relations	AASHTO T 180, Method B or D

PART 3 EXECUTION

3.1 DISCONNECTING EXISTING UTILITIES

[Prior to the start of work, the Government will disconnect and seal the utilities serving each area of alteration or removal.]

[Prior to the start of work, utilities serving each area of alteration or removal will be shut off by the Government and shall be disconnected and sealed by the Contractor.]

3.2 TEMPORARY UTILITY SERVICES

Install temporary utility services before disconnecting existing utilities. Contractor shall 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 shall comply with FAA AC 70/7460-1. Lights shall be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer. Maintain the temporary services during the period of construction and remove only after permanent services have been installed and tested and are in operation.

3.3 PRECAUTION AGAINST MOVEMENT

Contractor shall provide shoring and bracing or other supports to prevent movement, settlement, or collapse of facilities that are to remain which are adjacent to areas of alteration and removal.

3.4 DEMOLITION AND REMOVAL WORK

3.4.1 Demolition

3.4.1.1 Concurrent Earth-Moving Operations

Excavation, filling, and other earth-moving operations that are sequential to demolition work shall not be started in areas occupied by structures to be demolished until all demolition in the area has been completed and debris has been removed.

3.4.1.2 Buildings

Buildings shall be demolished or may be removed, subject to the approval of the Government and of the highway authorities having jurisdiction.

Demolition shall proceed in a systematic manner from the top of the structure to the ground. Demolition works above each tier or floor shall be completed before the supporting members on the lower levels are disturbed. Concrete and masonry walls shall be demolished in small sections. Structural framing members shall be removed and lowered by means of derricks, platform hoists, or other approved method.

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

Concrete slabs shall be broken up and removed.

3.4.1.3 Below-Grade Construction

[Foundation walls shall be demolished to a depth of not less than 12 inches below the existing ground surface. In addition, below-grade wood and metal construction and floor construction, except basement concrete slabs on ground, shall be demolished and removed.]

[Foundations, basement concrete slabs on ground footings, and other below-grade construction shall be demolished and removed.]

3.4.1.4 Filling Basements and Voids

Basements and voids resulting from the demolition of structures shall be completely filled with specified fill material and graded.

Prior to filling, basements and voids shall be free of standing water, frost, frozen material, trash, and debris.

Fill material shall be placed in horizontal layers not to exceed 12 inches in loose depth. Each layer shall be compacted to a minimum of 95 percent of the maximum density as determined by AASHTO T 180, Method D, at optimum moisture content.

After fill has been placed, the surface of the fill shall be graded to meet adjacent contours and to provide surface water drainage.

3.4.2 Protective Measures

Existing construction shall not be disturbed beyond the extent indicated or necessary for installation of new work. Temporary shoring and bracing shall be provided for support of building components to prevent settlement or other movement.

Protective measures shall be provided to control accumulation and migration of dust and dirt in all areas of work. Dust, dirt, and debris shall be removed from the areas of work daily.

3.4.3 Salvageable Materials and Equipment

Government will designate materials and equipment to be salvaged.

Salvageable materials and equipment shall be removed in a manner that will cause the least possible damage thereto. Contractor personnel shall handle, store, and protect removed items that are to be reused in the work or are to be retained by the Government.

Identification tags shall be provided on items boxed or placed in containers, indicating the type, size, and quantity of materials.

3.4.4 Scrap Metal

Scrap metal shall become the Contractor's property and shall be removed from the site as it accumulates.

3.4.5 Site Work

Chain link fencing, gates, and other salvaged items shall be removed and stored. Gates shall be removed as whole units. Chain link fabric shall be cut to lengths of 25 feet and stored in rolls off the ground.

3.4.6 Buildings and Structures

Specified removal operations shall be performed in existing buildings as required to complete the work.

Concrete:

Existing concrete shall be demolished, removed, and disposed of. Square, straight edges shall be provided where existing concrete adjoins new work and other locations. Existing steel reinforcement shall be protected where indicated or shall be cut off flush with face of concrete.

Masonry:

All masonry construction shall be demolished and removed.

Masonry units for reuse shall be removed, cleaned, and stacked off the ground on wood pallets. Salvaged masonry units not reused in the work shall remain the property of the Government. Damaged units unsuitable for reuse shall be considered as debris and shall be disposed. Salvaged masonry units shall be transported for storage to a location as directed by the Contracting Officer.

Structural steel:

Structural steel components shall be dismantled at field connections and in a manner that will prevent bending or damage.

When approved, flame-cutting torches may be used where other methods of dismantling are not practical.

Trusses and joists shall be transported as whole units and not dismantled.

Structural steel shall be transported to designated storage area, stacked according to size, type of member and length, and stored off the ground and protected from the weather.

Miscellaneous metals:

Shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, and similar items shall be salvaged as whole units.

Light-gage metal items, such as metal gutters, roofing and siding, and similar items, shall be salvaged unless designated as scrap metal by the Contracting Officer.

Carpentry:

Lumber, millwork items, and finished boards, except those that are unfit for reuse, shall be salvaged.

Windows, doors and frames, and similar items shall be removed as units, complete with trim and accessories. Hardware shall be left intact and attached to units, except that door closers shall be removed. Open end of door frames shall be braced to prevent damage thereto.

Gypsum board, fiberboard, and other composition sheathing boards shall be classified as debris to be removed and disposed of.

Demountable partitions, built-in furniture, toilet partitions, lockers, and other prefabricated units shall be removed in sections and salvaged.

Bolts, nuts, washers, timber connectors, and other rough hardware shall be classified as debris and disposed of.

Salvaged items shall be transported to designated storage area and stored as directed by the Contracting Officer.

Miscellaneous items:

Chalkboards, tackboards, toilet-room accessories, and similar surface-mounted items shall be removed and salvaged as whole units, complete with all accessories.

Venetian blinds, complete with hardware items which shall be packaged and attached thereto, shall be removed and salvaged.

Salvaged items shall be transported to designated storage area and stored as directed by the Contracting Officer.

3.4.7 Mechanical Equipment and Fixtures

Mechanical hardware shall be disconnected at the nearest convenient connection to existing services that are to remain.

Contractor shall remove all equipment NASA bar code or identification tags during demolition and forward the tags to the COTR.

Each item of equipment and fixtures shall be salvaged as a unit; listed, indexed, tagged, and stored. Each unit shall be salvaged with its normal operating auxiliary equipment.

Equipment shall not be removed until approved.

Disconnection from utilities:

Mechanical equipment and fixtures shall be disconnected at fittings. Service valves shall be removed and attached to the unit.

Preparation for storage:

Water, dirt, dust, and foreign matter shall be removed from units; tanks, piping and fixtures shall be drained; and interiors, if previously used to store flammable, explosive, or other dangerous liquids, shall be steam cleaned. Openings shall be sealed with caps, plates, or plugs.

Motors attached by flexible connections shall be secured to the unit.

Lubricating systems shall be charged with the proper oil or grease.

Piping:

Piping shall be disconnected at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. Salvaged piping shall be stored according to size and type. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control.

Piping that previously contained gas, gasoline, oil, or other dangerous fluids shall be carefully dismantled, with precautions taken to prevent injury to persons and property. Such piping shall be stored outdoors until all fumes and residues are removed.

Prefabricated supports, hangers, plates, valves, and specialty items shall be boxed according to size and type. Sprinkler heads shall be individually wrapped in plastic bags before boxing.

Piping not designated for salvage, or not reusable, shall be considered as scrap metal.

Ducts:

Removed duct work shall be classified as scrap metal.

Fixtures:

Fixtures associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations shall be removed and salvaged. Fixture units shall be tagged for identification, storage, and protection from damage.

Broken, damaged, or otherwise unserviceable units shall be classified as debris and disposed of by the Contractor.

Motor and machines:

Motors and machinery items associated with the plumbing, heating, air conditioning, refrigeration, and other mechanical system installations shall be removed and salvaged. Auxiliary units and accessories shall be salvaged and boxed and stored with the main unit.

Such items shall be tagged for identification, stored, and protected from damage.

Salvaged items shall be transported to designated storage area and stored as directed by the Contracting Officer.

3.4.8 Electrical Equipment and Fixtures

Motors, motor controllers, and operating and control equipment shall be salvaged and attached to the driven equipment.

Contractor shall remove all equipment NASA bar code or identification tags during demolition and forward the tags to the COTR.

Wiring systems and components shall be salvaged. Loose items shall be boxed and tagged for identification.

Primary, secondary, control, communication, and signal circuits shall be disconnected at the point of attachment to their distribution system.

Fixtures:

Electrical fixtures shall be removed and salvaged. Unprotected glassware shall be removed from the fixture and salvaged separately.

Incandescent lamps, mercury-vapor lamps, and fluorescent lamps shall be salvaged, boxed and tagged for identification, and protected from breakage.

Electrical devices:

Switches, receptacles, switchgear, transformers, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items shall be removed and salvaged. These items shall be boxed and tagged for identification according to

type and size.

Conductors:

Conductors, including insulated wire and nonmetallic sheathed and flexible armored cable, shall be removed and salvaged.

Conduit:

Conduit, except where embedded in concrete or masonry, shall be salvaged. Corroded, bent, or damaged conduit shall be considered as scrap metal. Straight, undamaged lengths shall be sorted and stockpiled according to size and type.

Wiring ducts or troughs:

Wiring ducts or troughs shall be removed and salvaged. Plug-in ducts and wiring troughs shall be disassembled into unit lengths. Plug-in or disconnecting devices shall be removed from the busway and stored separately.

Miscellaneous items:

Supports, knobs, tubes, cleats, and straps shall be classified as debris to be removed and disposed.

3.4.9 Elevators and Hoists

Elevators, hoists, and similar conveying equipment shall be removed and salvaged as whole units, to the most practical extent. Items shall be removed and prepared for salvage without damage to any of the various parts.

Rails for structural steel shall be salvaged and stored with the equipment as an integral part of the unit.

3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 General

Debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations shall be disposed of in accordance with all applicable federal, state and local regulations as contractually specified off the site. 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

Waste materials removed from demolished structures, shall be transported from Government property and legally disposed of. Waste soil shall be disposed of as directed.

3.6 REUSE OF SALVAGED ITEMS

Salvaged materials shall not be reused.

-- End of Section --

SECTION 02 82 00.98

ENGINEERING CONTROL OF ASBESTOS CONTAINING MATERIALS
02/13

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 Z9.2	(1979; R 1991) Fundamentals Governing the Design and Operation of Local Exhaust Systems
ANSI Z88.2	(1992) Respiratory Protection

ASTM INTERNATIONAL (ASTM)

ASTM C732	(2006; R 2012) Aging Effects of Artificial Weathering on Latex Sealants
ASTM D522	(1993a; R 2008) Mandrel Bend Test of Attached Organic Coatings
ASTM D1331	(1989; R 1995) Surface and Interfacial Tension of Solutions of Surface-Active Agents
ASTM D2794	(1993; R 2010) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM E84	(2012a) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96	(1995) Water Vapor Transmission of Materials
ASTM E119	(2012) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E736	(2000; R 2011) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
ASTM E1368	(2011) Visual Inspection of Asbestos Abatement Projects
ASTM E1494	(1992; R 2010) Encapsulants for Spray- or Trowel-Applied Friable Asbestos-Containing

	Building Materials

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

29 CFR 1926.103	Respiratory Protection
29 CFR 1926.51	Sanitation
29 CFR 1926.200	Accident Prevention Signs and Tags
29 CFR 1926.59	Hazard Communication
29 CFR 1926.1101	Asbestos
40 CFR 61-SUBPART A	General Provisions
40 CFR 61-SUBPART M	National Emission Standard for Asbestos
40 CFR 763	Asbestos

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 560/5-85-024	(1985) Guidance for Controlling Asbestos-Containing Materials in Buildings (Purple Book)

Ohio Administrative Code (OAC)

OAC 3701-34	(2005) Asbestos Hazard Abatement
OAC 3745-20	(2005) Asbestos Emission Control

UNDERWRITERS LABORATORIES (UL)

UL 586	(2009) Standard for High-Efficiency Particulate, Air Filter Units

1.2 DEFINITIONS

1.2.1 ACM

Asbestos Containing Materials.

1.2.2 Amended Water

Water containing a wetting agent or surfactant with a maximum surface tension of 29 dynes per centimeter when tested in accordance with ASTM D1331.

1.2.3 Area Sampling

Sampling of asbestos fiber concentrations which approximates the concentrations of asbestos in the theoretical breathing zone but is not actually collected in the breathing zone of an employee.

1.2.4 Asbestos

The term asbestos includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, and actinolite asbestos and any of these

minerals that has been chemically treated or altered. Materials are considered to contain asbestos if the asbestos content of the material is determined to be at least one percent.

1.2.5 Asbestos Control Area

That area where asbestos removal operations are performed which is isolated by physical boundaries which assist in the prevention of the uncontrolled release of asbestos dust, fibers, or debris.

1.2.6 Asbestos Fibers

Those fibers having an aspect ratio of at least 3:1 and longer than 5 micrometers as determined by National Institute for Occupational Safety and Health (NIOSH) Method 7400.

1.2.7 Asbestos Permissible Exposure Limit

0.1 fibers per cubic centimeter of air as an 8-hour time weighted average measured in the breathing zone as defined by 29 CFR 1926.1101 or other Federal legislation having legal jurisdiction for the protection of workers health.

1.2.8 Background

The ambient airborne asbestos concentration in an uncontaminated area as measured prior to any asbestos hazard abatement efforts. Background concentrations for other (contaminated) areas are measured in similar but asbestos free locations.

1.2.9 Contractor

The Contractor is that individual, or entity under contract to perform the herein listed work.

1.2.10 Encapsulation

The abatement of an asbestos hazard through the appropriate use of chemical encapsulants.

1.2.11 Encapsulants

Specific materials in various forms used to chemically or physically entrap asbestos fibers in various configurations to prevent these fibers from becoming airborne. There are four types of encapsulants as follows which must comply with performance requirements as specified herein.

a. Removal Encapsulant (can be used as a wetting agent)

b. Bridging Encapsulant (used to provide a tough, durable surface coating to asbestos containing material)

c. Penetrating Encapsulant (used to penetrate the asbestos containing material encapsulating all asbestos fibers and preventing fiber release due to routine mechanical damage)

d. Lock-Down Encapsulant (used to seal off or "lock-down" minute asbestos fibers left on surfaces from which asbestos containing material has been removed).

1.2.12 Friable Asbestos Material

One percent asbestos containing material that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

1.2.13 Glovebag Technique

Those asbestos removal and control techniques put forth in 29 CFR 1926.1101 Appendix G.

1.2.14 HEPA Filter Equipment

High efficiency particulate air (HEPA) filtered vacuum and/or exhaust ventilation equipment with a filter system capable of collecting and retaining asbestos fibers. Filters shall retain 99.97 percent of particles 0.3 microns or larger as indicated in UL 586.

1.2.15 NASA Consultant (NC)

That qualified person employed directly by the Government to monitor, sample, inspect the work or in some other way advise the Contracting Officer. The NC is normally a private consultant, but can be an employee of the Government.

1.2.16 Negative Pressure Enclosure (NPE)

That engineering control technique described as a negative pressure enclosure in 29 CFR 1926.1101.

1.2.17 Nonfriable Asbestos Material

Material that contains asbestos in which the fibers have been immobilized by a bonding agent, coating, binder, or other material so that the asbestos is well bound and will not normally release asbestos fibers during any appropriate use, handling, storage or transportation. It is understood that asbestos fibers may be released under other conditions such as demolition, removal, or mishap.

1.2.18 Personal Sampling

Air sampling which is performed to determine asbestos fiber concentrations within the breathing zone of a specific employee, as performed in accordance with 29 CFR 1926.1101.

1.2.19 Private Qualified Person (PQP)

That qualified person hired by the Contractor to perform the herein listed tasks.

1.2.20 Qualified Person (QP)

A Registered Architect, Professional Engineer, Certified Industrial Hygienist, consultant or other qualified person who has successfully completed training and is therefore accredited under a legitimate State Model Accrediation Plan as described in 40 CFR 763 as a Building Inspector, Contractor/Supervisor Abatement Worker, and Asbestos Project Designer; and has successfully completed the National Institute of Occupational Safety and Health (NIOSH) 582 course "Sampling and Evaluating

Airborne Asbestos Dust" or equivalent. The QP must be qualified to perform visual inspections as indicated in ASTM E1368. The QP shall be appropriately licensed in the State of Ohio.

1.2.21 TEM

Refers to Transmission Electron Microscopy.

1.2.22 Time Weighted Average (TWA)

The TWA is an 8-hour time weighted average airborne concentration of asbestos fibers.

1.2.23 Wetting Agent

A chemical added to water to reduce the water's surface tension thereby increasing the water's ability to soak into the material to which it is applied. An equivalent wetting agent must have a surface tension of at most 29 dynes per centimeter when tested in accordance with ASTM D1331.

1.3 REQUIREMENTS

1.3.1 Description of Work

The work covered by this section includes the handling and control of asbestos containing materials and describes some of the resultant procedures and equipment required to protect workers, the environment and occupants of the building or area, or both, from contact with airborne asbestos fibers. The work also includes the disposal of any asbestos containing materials generated by the work. More specific operational procedures shall be outlined in the Asbestos Hazard Abatement Plan called for elsewhere in this specification. The Government will evacuate the work area during the asbestos abatement work.

1.3.2 Medical Requirements

Provide medical requirements including but not limited to medical surveillance and medical record keeping as listed in 29 CFR 1926.1101.

1.3.2.1 Medical Examinations

Before exposure to airborne asbestos fibers, provide workers with a comprehensive medical examination as required by 29 CFR 1926.1101 or other pertinent State or local directives. This requirement must have been satisfied within the 12 months prior to the start of work on this contract. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos and within 30 calendar days before or after the termination of employment in such occupation. Specifically identify x-ray films of asbestos workers to the consulting radiologist and mark medical record jackets with the word "ASBESTOS."

1.3.2.2 Medical Records

Maintain complete and accurate records of employees' medical examinations, medical records, and exposure data for a period of [50 years] after termination of employment and make records of the required medical examinations and exposure data available for inspection and copying to: The Assistant Secretary of Labor for Occupational Safety and Health

(OSHA), or authorized representatives of them, and an employee's physician upon the request of the employee or former employee.

1.3.3 Training

Train all personnel involved in the asbestos control work in accordance with United States Environmental Protection Agency (USEPA) Asbestos Hazard Emergency Response Act (AHERA) training criteria or State training criteria whichever is more stringent. The Contractor shall document the training by providing: dates of training, training entity, course outline, names of instructors, and qualifications of instructors upon request by the Contracting Officer. Furnish each employee with respirator training and fit testing administered by the PQP as required by 29 CFR 1926.1101. Fully cover engineering and other hazard control techniques and procedures.

1.3.4 Permits, Licenses, and Notifications

Obtain necessary permits and licenses in conjunction with asbestos removal, encapsulation, hauling, and disposition, and furnish notification of such actions required by Federal, State, regional, and local authorities prior to the start of work. Notify the local air pollution control district/agency and the Contracting Officer in writing 10 working days prior to commencement of work in accordance with 40 CFR 61-SUBPART M.

1.3.5 Environment, Safety and Health Compliance

In addition to detailed requirements of this specification, comply with those applicable laws, ordinances, criteria, rules, and regulations of Federal, State, regional, and local authorities regarding handling, storing, transporting, and disposing of asbestos waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.1101, 40 CFR 61-SUBPART A, and 40 CFR 61-SUBPART M. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting the work. Where the requirements of this specification, applicable laws, rules, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirement as defined by the Government shall apply. The following laws, ordinances, criteria, rules and regulations regarding removal, handling, storing, transporting and disposing of asbestos materials apply:

a. OAC 3701-34

b. OAC 3745-20

c. 40 CFR 763

1.3.6 Respiratory Protection Program

Establish and implement a respirator program as required by ANSI Z88.2, 29 CFR 1926.1101, and 29 CFR 1926.103. Submit a written description of the program to the Contracting Officer.

1.3.7 Asbestos Hazard Control Supervisor

The Contractor shall be represented on site by a supervisor, trained using the model Contractor accreditation plan as indicated in the Federal statutes for all portions of the herein listed work.

1.3.8 Hazard Communication

Adhere to all parts of 29 CFR 1926.59 and provide the Contracting Officer with a copy of the Material Safety Data Sheets (MSDS) for all materials brought to the site.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00.98 SUBMITTAL PROCEDURES:

1.4.1 SD-03, Product Data

a. Local exhaust equipment

b. Vacuums

c. Respirators

d. Pressure differential automatic recording instrument

e. Amended water

f. Material Safety Data Sheets (MSDS) for all materials proposed for transport to the project site

g. Encapsulants

1.4.2 SD-06, Test Reports

a. Air sampling results

b. Pressure differential recordings for local exhaust system

c. Asbestos disposal quantity report

d. Encapsulation test patches

e. Clearance sampling

1.4.2.1 Air Sampling Results

Complete fiber counting and provide results to the PQP and NC for review within 16 hours of the "time off" of the sample pump. Notify the Contracting Officer immediately of any airborne levels of asbestos fibers in excess of the acceptable limits. Submit sampling results to the Contracting Officer and the affected Contractor employees where required by law within 3 working days, signed by the testing laboratory employee performing air sampling, the employee that analyzed the sample, and the PQP and NC. Notify the Contractor and the Contracting Officer immediately of any variance in the pressure differential which could cause adjacent unsealed areas to have asbestos fiber concentrations in excess of 0.01 fibers per cubic centimeter or background whichever is higher. In no circumstance shall levels exceed 0.1 fibers per cubic centimeter.

1.4.2.2 Pressure Differential Recordings for Local Exhaust System

Provide a local exhaust system that creates a negative pressure of at least 0.02 inches of water relative to the pressure external to the enclosure and operate it continuously, 24 hours a day, until the temporary enclosure of the asbestos control area is removed. Submit pressure differential recordings for each work day to the PQP for review and to the Contracting Officer within 24 hours from the end of each work day.

1.4.3 SD-07, Certificates

a. Asbestos hazard abatement plan

b. Testing laboratory

c. Private qualified person documentation

d. Landfill approval

e. Employee training

f. Medical certification requirements

g. Waste shipment records and if applicable exemption report

h. Respiratory Protection Program

i. Hazardous waste manifest

j. Vacuums

k. Water filtration equipment

l. Ventilation systems

m. Other equipment used to contain airborne asbestos fibers

n. Chemical encapsulants sealers

o. Notifications

p. Rental equipment

q. Respirator program records

r. Permits

s. Final Asbestos Closeout Report

Show compliance with ANSI Z9.2 by providing manufacturers' certificates.

1.4.3.1 Asbestos Hazard Abatement Plan

Submit a detailed plan of the safety precautions such as lockout, tagout, tryout, fall protection, and confined space entry procedures and equipment and work procedures to be used in the encapsulation removal and demolition of materials containing asbestos. The plan shall be prepared, signed, and sealed by the PQP. Such plan shall include but not be limited to the precise personal protective equipment to be used including, but not

limited to, respiratory protection, type of whole-body protection , the location of asbestos control areas including clean and dirty areas, buffer zones, showers, storage areas, change rooms, removal method, interface of trades involved in the construction, sequencing of asbestos related work, disposal plan, type of wetting agent and asbestos sealer to be used, locations of local exhaust equipment, planned air monitoring strategies, and a detailed description of the method to be employed in order to control environmental pollution. The plan shall also include (both fire and medical emergency) response plans. The Asbestos Hazard Abatement Plan must be approved in writing prior to starting any asbestos work. The Contractor, Asbestos Hazard Control Supervisor, and PQP shall meet with the Contracting Officer prior to beginning work, to discuss in detail the Asbestos Hazard Abatement Plan, including work procedures and safety precautions. Once approved by the Contracting Officer, the plan will be enforced as if an addition to the specification. Any changes required in the specification as a result of the plan shall be identified specifically in the plan to allow for free discussion and approval by the Contracting Officer prior to starting work.

1.4.3.2 Testing Laboratory

Submit the name, address, and telephone number of each testing laboratory selected for the sampling, analysis, and reporting of airborne concentrations of asbestos fibers along with evidence that each laboratory selected holds the appropriate State license and/or permits and certification that each laboratory is American Industrial Hygiene Association (AIHA) accredited and that persons counting the samples have been judged proficient by current inclusion on the AIHA Asbestos Analysis Registry (AAR) and successful participation of the laboratory in the Proficiency Analytical Testing (PAT) Program. Where analysis to determine asbestos content in bulk materials or transmission electron microscopy is required, submit evidence that the laboratory is accredited by the National Institute of Science and Technology (NIST) under National Voluntary Laboratory Accreditation Program (NVLAP) for asbestos analysis.

1.4.3.3 Private Qualified Person Documentation

Submit the name, address, and telephone number of the Private Qualified Person (PQP) selected to prepare the Asbestos Hazard Abatement Plan, direct monitoring and training, and documented evidence that the PQP has successfully completed training in and is accredited and where required is certified as, a Building Inspector, Contractor/Supervisor Abatement Worker, and Asbestos Project Designer as described by 40 CFR 763 and has successfully completed the National Institute of Occupational Safety and Health (NIOSH) 582 course "Sampling and Evaluating Airborne Asbestos Dust" or equivalent. The PQP shall be appropriately licensed in the State of Ohio.

1.4.3.4 Landfill Approval

Submit written evidence that the landfill for disposal is approved for asbestos disposal by the USEPA and State and local regulatory agency(s). Submit to the Contracting Officer, waste shipment records, prepared in accordance with Federal regulations, signed and dated by an agent of the landfill, certifying the amount of asbestos materials delivered to the landfill, within 3 days after delivery. In those States that require a hazardous waste manifest the Contractor shall submit, within 3 days, signed copies of such to the Contracting Officer.

1.4.3.5 Employee Training

Submit certificates signed by each employee indicating that the employee has received training in the proper handling of materials and wastes that contain asbestos in accordance with 40 CFR 763; understands the health implications and risks involved, including the illnesses possible from exposure to airborne asbestos fibers; understands the use and limits of the respiratory equipment to be used; and understands the results of monitoring of airborne quantities of asbestos as related to health and respiratory equipment as indicated in 29 CFR 1926.1101 on an initial and annual basis. Post appropriate evidence of compliance with the training requirements of 40 CFR 763.

1.4.3.6 Medical Certification

Provide a written certification for each worker and supervisor, signed by a licensed physician indicating that the worker and supervisor has met or exceeded all of the medical prerequisites listed herein and in 29 CFR 1926.1101 and 29 CFR 1926.103 as prescribed by law.

1.4.3.7 Respiratory Protection Program

Submit a written program manual or operating procedure including methods of compliance with regulatory statutes.

1.4.3.8 Notifications

Notify the Contracting Officer and other appropriate Government agencies in writing 10 working days prior to the start of asbestos work as indicated in applicable laws, ordinances, criteria, rules, and regulations. Notify the local fire department 3 days prior to removing fire-proofing material from the building including notice that the material contains asbestos.

1.4.3.9 Rental Equipment

Provide a copy of the written notification to the rental company concerning the intended use of the equipment and the possibility of asbestos contamination of the equipment.

1.4.3.10 Respirator Program Records

Submit records of the respirator program as required by ANSI Z88.2, 29 CFR 1926.103, and 29 CFR 1926.1101.

1.4.3.11 Final Asbestos Close Report

Provide a final asbestos close-out report within 20 days after the work is complete. The final close-out report shall have the following elements:A brief summary of the asbestos work, include asbestos material type and quantities removed. A brief summary of the abatement controls (glovebag, criticals only, full containment, etc.) A brief summary of the PPE used by the workers. A list of all asbestos workers and supervisors at the project site (project sign-in sheet). Copies of worker training, ODH certification, fit testing, and medical clearance documentation. Copy of the ODH and EPA notification. OSHA air monitoring results. Environmental air monitoring results (if conducted). Final visual inspection documentation from a certified independent third party. Final air monitoring documentation from a certified independent third party. Any

other information pertinent to the project.

PART 2 PRODUCTS

2.1 ENCAPSULANTS

Shall conform to current USEPA requirements, shall contain no toxic or hazardous substances as defined in 29 CFR 1926.59, and shall conform to the following performance requirements.

2.1.1 Removal Encapsulants

Requirement	Test Standard
Flame Spread - 25, Smoke Emission - 50	ASTM E84
Life Expectancy - 20 years	ASTM C 732 Accelerated Aging Test
Permeability - Minimum 0.4 perms	ASTM E96

2.1.2 Bridging Encapsulant

Requirement	Test Standard
Flame Spread - 25, Smoke Emission - 50	ASTM E84
Life Expectancy - 20 years	ASTM C732 Accelerated Aging Test
Permeability - Minimum 0.4 perms	ASTM E96
Fire Resistance - Negligible affect on fire resistance rating over 3 hour test (Classified by UL for use over fibrous and cementitious sprayed fireproofing)	ASTM E119
Impact Resistance - Minimum 43 in/lb	ASTM D2794 Gardner Impact Test
Flexibility - no rupture or cracking	ASTM D522 Mandrel Bend Test

2.1.3 Penetrating Encapsulant

Requirement	Test Standard
Flame Spread - 25, Smoke Emission - 50	ASTM E84
Life Expectancy - 20 years	ASTM C732 Accelerated Aging Test
Permeability - Minimum 0.4 perms	ASTM E96
Cohesion/Adhesion Test - 50 pounds of force/foot	ASTM E736
Fire Resistance - Negligible affect on fire resistance rating over 3 hour test	ASTM E119

Requirement	Test Standard
(Classified by UL for use over fibrous and cementitious sprayed fireproofing)	
Impact Resistance - Minimum 43 in/lb	ASTM D2794 Gardner Impact Test
Flexibility - no rupture or cracking	ASTM D522 Mandrel Bend Test

2.1.4 Lock-down Encapsulant

Requirement	Test Standard
Flame Spread: 25, Smoke Emission - 50	ASTM E84
Life Expectancy: 20 years	ASTM C732 Accelerated Aging Test
Permeability: Minimum 0.4 perms	ASTM E96
Fire Resistance: Negligible affect on fire resistance rating over 3 hour test (Tested with fireproofing over encapsulant applied directly to steel member)	ASTM E119
Bond Strength: 100 pounds of force/foot (Tests compatibility with cementitious and fibrous fireproofing)	ASTM E736

PART 3 EXECUTION

3.1 EQUIPMENT

At all times, provide the Contracting Officer or the Contracting Officer's Representative, with at least two complete sets of personal protective equipment [including decontaminating reusable coveralls] as required for entry to and inspection of the asbestos control area. Provide equivalent training to the Contracting Officer or a designated representative as provided to Contractor employees in the use of the required personal protective equipment. Provide manufacturer's certificate of compliance for all equipment used to contain airborne asbestos fibers.

3.1.1 Respirators

Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services.

3.1.1.1 Respirators for Handling Asbestos

Provide personnel engaged in pre-cleaning, cleanup, handling, [encapsulation] [removal] [and] [or] [demolition] of asbestos materials with respiratory protection as indicated in 29 CFR 1926.1101 and 29 CFR 1926.103.

3.1.2 Exterior Whole Body Protection

3.1.2.1 Outer Protective Clothing

Provide personnel exposed to asbestos with disposable "non-breathable," [or reusable "non-breathable"] whole body outer protective clothing, head coverings, gloves, and foot coverings. Provide disposable plastic or rubber gloves to protect hands. Cloth gloves may be worn inside the plastic or rubber gloves for comfort, but shall not be used alone. Make sleeves secure at the wrists, make foot coverings secure at the ankles, and make clothing secure at the neck by the use of tape.

3.1.2.2 Work Clothing

Provide cloth work clothes for wear under the outer protective clothing and foot coverings and either dispose of or properly decontaminate them as recommended by the PQP after each use.

3.1.2.3 Personal Decontamination Unit

Provide a temporary, negative pressure unit with a separate decontamination locker room and clean locker room with a shower that complies with 29 CFR 1926.51(f)(4)(ii) through (V) in between for personnel required to wear whole body protective clothing. Provide two separate lockers for each asbestos worker, one in each locker room. Keep street clothing and street shoes in the clean locker. HEPA vacuum and remove asbestos contaminated disposable protective clothing while still wearing respirators at the boundary of the asbestos work area and seal in impermeable bags or containers for disposal. Do not wear work clothing between home and work. Locate showers between the decontamination locker room and the clean locker room and require that all employees shower before changing into street clothes. Collect used shower water and filter with approved water filtration equipment to remove asbestos contamination. Dispose of filters and residue as asbestos waste. Discharge clean water to the sanitary system. Dispose of asbestos contaminated work clothing as asbestos contaminated waste . Decontamination units shall be physically attached to the asbestos control area. Build both a personnel decontamination unit and an equipment decontamination unit onto and integral with each asbestos control area.

3.1.2.4 Eye Protection

Provide goggles to personnel engaged in asbestos abatement operations when the use of a full face respirator is not required.

3.1.3 Warning Signs and Labels

Provide warning signs in English at all approaches to asbestos control areas. Locate signs at such a distance that personnel may read the sign and take the necessary protective steps required before entering the area. Provide labels and affix to all asbestos materials, scrap, waste, debris, and other products contaminated with asbestos.

3.1.3.1 Warning Sign

Provide vertical format conforming to 29 CFR 1926.200, and 29 CFR 1926.1101 minimum 20 by 14 inches displaying the following legend in the lower panel:

Legend	Notation
Danger	1-inch Sans Serif Gothic or Block
Asbestos	1-inch Sans Serif Gothic or Block
Cancer and Lung Disease Hazard	1/4-inch Sans Serif Gothic or Block
Authorized Personnel Only	1/4-inch Gothic
Respirators and Protective Clothing are Required in this Area	1/4-inch Gothic

Spacing between lines shall be at least equal to the height of the upper of any two lines.

3.1.3.2 Warning Labels

Provide labels conforming to 29 CFR 1926.1101 of sufficient size to be clearly legible, displaying the following legend:

DANGER

CONTAINS ASBESTOS FIBERS

AVOID CREATING DUST

CANCER AND LUNG DISEASE HAZARD

BREATHING ASBESTOS DUST MAY
CAUSE SERIOUS BODILY HARM

3.1.4 Local Exhaust System

Provide a local exhaust system in the asbestos control area in accordance with ANSI Z9.2 and 29 CFR 1926.1101 that will provide at least four air changes per hour inside of the negative pressure enclosure. Local exhaust equipment shall be operated 24 hours per day, until the asbestos control area is removed and shall be leak proof to the filter and equipped with HEPA filters. Maintain a minimum pressure differential in the control area of minus 0.02 inch of water column relative to adjacent, unsealed areas. Provide continuous 24-hour per day monitoring of the pressure differential with a pressure differential automatic recording instrument. In no case shall the building ventilation system be used as the local exhaust system for the asbestos control area. Filters on exhaust equipment shall conform to ANSI Z9.2 and UL 586. The local exhaust system shall terminate out of doors and remote from any public access or ventilation system intakes.

3.1.5 Tools

Vacuums shall be leak proof to the filter and equipped with HEPA filters.

Filters on vacuums shall conform to ANSI Z9.2 and UL 586. Do not use power tools to remove asbestos containing materials unless the tool is equipped with effective, integral HEPA filtered exhaust ventilation systems. Remove all residual asbestos from reusable tools prior to storage or reuse.

3.1.6 Rental Equipment

If rental equipment is to be used, furnish written notification to the rental agency concerning the intended use of the equipment and the possibility of asbestos contamination of the equipment.

3.1.7 Glovebags

Submit written manufacturers proof that glovebags will not break down under expected temperatures and conditions.

3.2 WORK PROCEDURE

Perform asbestos related work in accordance with 29 CFR 1926.1101, 40 CFR 61-SUBPART M, and as specified herein. Use wet removal procedures or appropriate encapsulation procedures as listed in the asbestos hazard abatement plan and negative pressure enclosure techniques. Personnel shall wear and utilize protective clothing and equipment as specified herein. Eating, smoking, drinking, chewing gum, tobacco, or applying cosmetics shall not be permitted in the asbestos work or control areas. Personnel of other trades not engaged in the encapsulation removal and demolition of asbestos containing material shall not be exposed at any time to airborne concentrations of asbestos unless all the personnel protection and training provisions of this specification are complied with by the trade personnel. Shut down the building heating, ventilating, and air conditioning system, cap the openings to the system, prior to the commencement of asbestos work. Disconnect electrical service when [encapsulation] [wet removal] is performed and provide temporary electrical service with verifiable ground fault circuit interrupter (GFCI) protection prior to the use of any water or encapsulant. If an asbestos fiber release or spill occurs outside of the asbestos control area], stop work immediately, correct the condition to the satisfaction of the Contracting Officer including clearance sampling, prior to resumption of work.

3.2.1 Protection of Existing Work to Remain

Perform work without damage or contamination of adjacent work. Where such work is damaged or contaminated as verified by the Contracting Officer using visual inspection or sample analysis, it shall be restored to its original condition or decontaminated by the Contractor at no expense to the Government as deemed appropriate by the Contracting Officer. This includes inadvertent spill of dirt, dust, or debris in which it is reasonable to conclude that asbestos may exist. When these spills occur, stop work immediately. Then clean up the spill. When satisfactory visual inspection and air sampling results are obtained from the [PQP] [NC] work may proceed at the discretion of the Contracting Officer.

3.2.2 Furnishings

Furniture and equipment will be removed from the area of work by the Government before asbestos work begins.

3.2.3 Precleaning

Wet wipe and HEPA vacuum all surfaces potentially contaminated with asbestos prior to establishment of an enclosure.

3.2.4 Asbestos Control Area Requirements

3.2.4.1 Negative Pressure Enclosure

Block and seal openings in areas where the release of airborne asbestos fibers can be expected. Establish an asbestos negative pressure enclosure with the use of curtains, portable partitions, or other enclosures in order to prevent the escape of asbestos fibers from the contaminated asbestos work area. Negative pressure enclosure development shall include protective covering of uncontaminated walls, and ceilings with a continuous membrane of two layers of minimum 6-mil plastic sheet sealed with tape to prevent water or other damage. Provide two layers of 6-mil plastic sheet over floors and extend a minimum of 12 inches up walls. Seal all joints with tape. Provide local exhaust system in the asbestos control area. Openings will be allowed in enclosures of asbestos control areas for personnel and equipment entry and exit, the supply and exhaust of air for the local exhaust system and the removal of properly containerized asbestos containing materials. Replace local exhaust system filters as required to maintain the efficiency of the system.

3.2.4.2 Glovebag

The construction of a negative pressure enclosure is infeasible for the removalor encapsulation. Use alternate techniques as indicated in 29 CFR 1926.1101. Establish designated limits for the asbestos regulated area with the use of rope or other continuous barriers, and maintain all other requirements for asbestos control areas. The PQP shall conduct personal samples of each worker engaged in asbestos handling (removal, disposal, transport and other associated work) throughout the duration of the project. If the quantity of airborne asbestos fibers monitored at the breathing zone of the workers at any time exceeds background or 0.01 fibers per cubic centimeter whichever is greater, stop work, evacuate personnel in adjacent areas or provide personnel with approved protective equipment at the discretion of the Contracting Officer. This sampling may be duplicated by the Government at the discretion of the Contracting Officer. If the air sampling results obtained by the Government differ from those obtained by the Contractor, the Government will determine which results predominate. If adjacent areas are contaminated as determined by the Contracting Officer, clean the contaminated areas, monitor, and visually inspect the area as specified herein.

3.2.4.3 Mini-Enclosures

Mini-containment (small walk-in enclosure) to accommodate no more than two (2) persons, may be used if the disturbance or removal can be completely contained by the enclosure. The mini-enclosure shall be constructed of minimum 6-mil plastic. The mini-enclosure shall be inspected for leaks and smoke tested before each use. Negative pressure shall be established by use of a HEPA filtered ventilation unit. Air movement shall be directed away from the employee's breathing zone within the mini-enclosure. A decontamination unit shall be attached to mini-enclosure.]

3.2.5 [Removal Procedures

Wet asbestos material with a fine spray of amended water during removal, cutting, or other handling so as to reduce the emission of airborne fibers. Remove material and immediately place in 6-mil plastic disposal bags. Remove asbestos containing material in a gradual manner, with continuous application of the amended water or wetting agent in such a manner that no asbestos material is disturbed prior to being adequately wetted. Where unusual circumstances prohibit the use of 6-mil plastic bags, submit an alternate proposal for containment of asbestos fibers to the Contracting Officer for approval. For example, in the case where both piping and insulation are to be removed, the Contractor may elect to wet the insulation, wrap the pipes and insulation in plastic and remove the pipe by sections. Asbestos containing material shall be containerized while wet. At no time shall asbestos material be allowed to accumulate or become dry. Lower and otherwise handle asbestos containing material as indicated in 40 CFR 61-SUBPART M.

3.2.5.1 Sealing Contaminated Items Designated for Disposal

Remove contaminated architectural, mechanical, and electrical appurtenances such as venetian blinds, full-height partitions, carpeting, duct work, pipes and fittings, radiators, light fixtures, conduit, panels, and other contaminated items designated for removal by completely coating the items with an asbestos lock-down encapsulant at the demolition site before removing the items from the asbestos control area. These items need not be vacuumed. The asbestos lock-down encapsulant shall be tinted a contrasting color. It shall be spray-applied by airless method. Thoroughness of sealing operation shall be visually gauged by the extent of colored coating on exposed surfaces. Lock-down encapsulants shall comply with the performance requirements specified herein.

3.2.5.2 Exposed Pipe Insulation Edges

Contain edges of asbestos insulation to remain that are exposed by a removal operation. Wet and cut the rough ends true and square with sharp tools and then encapsulate the edges with a 1/4-inch thick layer of non-asbestos containing insulating cement troweled to a smooth hard finish. When cement is dry, lag the end with a layer of non-asbestos lagging cloth, overlapping the existing ends by at least 4 inches. When insulating cement and cloth is an impractical method of sealing a raw edge of asbestos, take appropriate steps to seal the raw edges as approved by the Contracting Officer.

3.2.6 Encapsulation Procedures

3.2.6.1 Preparation of Test Patches

Install three test patches of encapsulant in areas, as indicated. Use airless spray at the lowest pressure and as recommended by the encapsulant manufacturer. Follow exactly the manufacturer's instructions for thinning recommendations, application procedures and rates. Curing time shall be not less than five days or that recommended by the manufacturer, whichever is more. A test patch shall be 9 square feet in size.

3.2.6.2 Field Testing

Field test the encapsulation test patches in accordance with ASTM E1494, paragraph "Required Field Test," in the presence of the Contracting

Officer. Keep a written record of the testing procedures and test results. Upon successful testing of the encapsulant, submit a signed statement to the Contracting Officer certifying that the encapsulant is suitable for installation on the particular asbestos containing material.

3.2.6.3 Large-Scale Application

Apply encapsulant using the same equipment and procedures as employed for the test patches. Keep the encapsulant material stirred to prevent settling. Keep a clean work area. Change pre-filters in the ventilation equipment as soon as they appear clogged by encapsulant aerosol or pressure differential drops below 0.02 Hg.

3.2.7 Air Sampling

Sampling of airborne concentrations of asbestos fibers shall be performed in accordance with 29 CFR 1926.1101 and as specified herein. Sampling performed in accordance with 29 CFR 1926.1101 shall be performed by the PQP. [Sampling performed for environmental and quality control reasons shall be performed by the PQP.] Unless otherwise specified, use NIOSH Method 7400 for sampling and analysis. Monitoring may be duplicated by the Government at the discretion of the Contracting Officer. If the air sampling results obtained by the Government differ from those results obtained by the Contractor, the Government will determine which results predominate.

3.2.7.1 Sampling Prior to Asbestos Work

Provide area air sampling and establish the baseline one day prior to the masking and sealing operations for each removal0 site. Establish the background by performing area sampling in similar but uncontaminated sites in the building.

3.2.7.2 Sampling During Asbestos Work

The PQP shall provide personal and area sampling as indicated in 29 CFR 1926.1101 and governing environmental regulations. In addition, provided the same type of work is being performed, provide area sampling at least once every work shift close to the work inside the enclosure, outside the clean room entrance to the enclosure, and at the exhaust opening of the local exhaust system. If sampling outside the enclosure shows airborne levels have exceeded background or 0.01 fibers per cubic centimeter, whichever is greater, stop all work, correct the condition(s) causing the increase, and notify the Contracting Officer immediately. Where alternate methods are used, perform personal and area air sampling at locations and frequencies that will accurately characterize the evolving airborne asbestos levels.

3.2.7.3 Sampling After Final Clean-Up (Clearance Sampling)

Provide area sampling of asbestos fibers using aggressive air sampling techniques as defined in the EPA 560/5-85-024 and establish an airborne asbestos concentration of less than 0.01 fibers per cubic centimeter after final clean-up but before removal of the enclosure or the asbestos work control area. After final cleanup and the asbestos control area is dry but prior to clearance sampling, the PQP shall perform a visual inspection in accordance with ASTM E1368 to ensure that the asbestos control and work

area is free of any accumulations of dirt, dust, or debris. Prepare a written report signed and dated by the PQP documenting that the asbestos control area is free of dust, dirt, and debris and all waste has been removed. Perform at least 1 samples.Use transmission electron microscopy (TEM) to analyze clearance samples and report the results in accordance with current NIOSH criteria. The asbestos fiber counts from these samples shall be less than 0.01 fibers per cubic centimeter or be not greater than the background, whichever is greater. Should any of the final samples indicate a higher value, the Contractor shall take appropriate actions to re-clean the area and shall repeat the sampling and TEM analysis at the Contractor's expense.

3.2.8 Lock-Down

Prior to removal of plastic barriers and after pre-clearance clean up of gross contamination, the PQP shall conduct a visual inspection of all areas affected by the removalor encapsulation in accordance with ASTM E1368. Inspect for any visible fibers , and to ensure that encapsulants were applied evenly and appropriately. A post removal (lock-down) encapsulant shall then be spray applied to ceiling, walls, floors and other areas exposed in the removal area. The exposed area shall include but not be limited to plastic barriers, furnishings and articles to be discarded as well as dirty change room, air locks for bag removal and decontamination chambers.

3.2.9 Site Inspection

While performing asbestos engineering control work, the Contractor shall be subject to on-site inspection by the Contracting Officer who may be assisted by or represented by safety or industrial hygiene personnel. If the work is found to be in violation of this specification, the Contracting Officer or his representative will issue a stop work order to be in effect immediately and until the violation is resolved. All related costs including standby time required to resolve the violation shall be at the Contractor's expense.

3.3 CLEAN-UP AND DISPOSAL

3.3.1 Housekeeping

Essential parts of asbestos dust control are housekeeping and clean-up procedures. Maintain surfaces of the asbestos control area free of accumulations of asbestos fibers. Give meticulous attention to restricting the spread of dust and debris; keep waste from being distributed over the general area. Use HEPA filtered vacuum cleaners. DO NOT BLOW DOWN THE SPACE WITH COMPRESSED AIR. When asbestos removal is complete, all asbestos waste is removed from the work-site, and final clean-up is completed, the Contracting Officer will attest that the area is safe before the signs can be removed. After final clean-up and acceptable airborne concentrations are attained but before the HEPA unit is turned off and the enclosure removed, remove all pre-filters on the building HVAC system and provide new pre-filters. Dispose of filters as asbestos contaminated materials. Reestablish HVAC mechanical, and electrical systems in proper working order. The Contracting Officer will visually inspect all surfaces within the enclosure for residual material or accumulated dust or debris. The Contractor shall re-clean all areas showing dust or residual materials. If re-cleaning is required, air sample and establish an acceptable asbestos airborne concentration after re-cleaning. The Contracting Officer must agree that the area is safe in

writing before unrestricted entry will be permitted. The Government shall have the option to perform monitoring to determine if the areas are safe before entry is permitted.

3.3.2 Title to Materials

All waste materials, except as specified otherwise, shall become the property of the Contractor and shall be disposed of as specified in applicable local, State, and Federal regulations and herein.

3.3.3 Disposal of Asbestos

3.3.3.1 Procedure for Disposal

Collect asbestos waste, asbestos contaminated water, scrap, debris, bags, containers, equipment, and asbestos contaminated clothing which may produce airborne concentrations of asbestos fibers and place in sealed fiber-proof, waterproof, non-returnable containers (e.g. double plastic bags 6-mils thick, cartons, drums or cans). Wastes within the containers must be adequately wet in accordance with 40 CFR 61-SUBPART M. Affix a warning and Department of Transportation (DOT) label to each container including the bags or use at least 6-mils thick bags with the approved warnings and DOT labeling preprinted on the bag. The name of the waste generator and the location at which the waste was generated shall be clearly indicated on the outside of each container. Prevent contamination of the transport vehicle (especially if the transport vehicle is a rented truck likely to be used in the future for non-asbestos purposes). These precautions include lining the vehicle cargo area with plastic sheeting (similar to work area enclosure) and thorough cleaning of the cargo area after transport and unloading of asbestos debris is complete. Dispose of waste asbestos material at an Environmental Protection Agency (EPA) or State-approved asbestos landfill off Government property. For temporary storage, store sealed impermeable bags in asbestos waste drums or skids. An area for interim storage of asbestos waste-containing drums or skids will be assigned by the Contracting Officer or his authorized representative. Procedure for hauling and disposal shall comply with 40 CFR 61-SUBPART M, State, regional, and local standards. Sealed plastic bags may be dumped from drums into the burial site unless the bags have been broken or damaged. Damaged bags shall remain in the drum and the entire contaminated drum shall be buried. Uncontaminated drums may be recycled. Workers unloading the sealed drums shall wear appropriate respirators and personal protective equipment when handling asbestos materials at the disposal site.

3.3.3.2 Asbestos Disposal Quantity Report

Direct the PQP to record and report, to the Contracting Officer, the amount of asbestos containing material removed and released for disposal. Deliver the report for the previous day at the beginning of each day shift with amounts of material removed during the previous day reported in linear feet or square feet as described initially in this specification and in cubic feetfor the amount of asbestos containing material released for disposal.

-- End of Section --

SECTION 02 83 00.98

LEAD PAINT ABATEMENT
02/13

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 Z9.2	(1979; R 1991) Fundamentals Governing the Design and Operation of Local Exhaust Systems
ANSI Z88.2	(1992) Respiratory Protection

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

29 CFR 1926.21	Safety Training and Education
29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.59	Hazard Communication
29 CFR 1926.62	Lead
29 CFR 1926.65	Hazardous Waste Operations and Emergency Response
29 CFR 1926.103	Respiratory Protection
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268	Land Disposal Restrictions

40 CFR 745	Lead-Based Paint Poisoning Prevention in Certain Residential Structures
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 178	Specifications for Packagings

UNDERWRITERS LABORATORIES (UL)

UL 586	(2009) Standard for High-Efficiency Particulate, Air Filter Units

1.2 DEFINITIONS

1.2.1 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period in an occupational/industrial environment.

1.2.2 Area Sampling

Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel.

1.2.3 Competent Person (CP)

As used in this section, refers to a person employed by the Contractor who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations. An industrial hygienist or safety professional certified for comprehensive practice by the American Board of Industrial Hygiene or by the Board of Certified Safety Professionals is the best choice.

1.2.4 Contaminated Room

Room for removal of contaminated personal protective equipment (PPE).

1.2.5 Decontamination Shower Facility

That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal rooms, with a shower facility in between.

1.2.6 Eight-Hour Time Weighted Average (TWA)

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

1.2.7 High Efficiency Particulate Air (HEPA) Filter Equipment

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

1.2.8 Lead

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

1.2.9 Lead Based Paint (LBP)

Protective or decorative coating which contains lead.

1.2.10 Lead Control Area

An enclosed area or structure, constructed as a temporary containment equipped with HEPA filtered local exhaust, which prevents the spread of lead dust, paint chips, or debris existing as a condition of lead based paint removal operations. The lead control area is also isolated by physical boundaries to prevent unauthorized entry of personnel.

1.2.11 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than eight hours in a work day, the PEL shall be determined by the following formula:

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

1.2.12 Personal Sampling

Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employees' work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of six to nine inches and centered at the nose or mouth of an employee.

1.2.13 Physical Boundary

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

1.3 QUALITY ASSURANCE

1.3.1 Medical Examinations

Before exposure to lead-contaminated dust, provide workers with a comprehensive medical examination as required by 29 CFR 1926.62 and 29 CFR 1926.103. The examination will not be required if adequate records show that employees have been examined as required by 29 CFR 1926.62 within the last year.

1.3.1.1 Medical Records

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

1.3.1.2 Medical Surveillance

Provide medical surveillance to all personnel exposed to lead as indicated in 29 CFR 1926.62.

1.3.2 Competent Person (CP) Responsibilities

a. Certify training as meeting all federal, State, and local requirements.

b. Review and approve lead based paint removal plan for conformance to the applicable referenced standards.

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

d. Perform air and wipe sampling.

e. Ensure work is performed in strict accordance with specifications at all times.

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

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

1.3.3 Training

Train each employee performing paint removal, disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 29 CFR 1926.21, 29 CFR 1926.62, and State and local regulations.

1.3.3.1 Training Certification

Submit a certificate for each employee, signed and dated by the approved training source, stating that the employee has received the required lead training.

1.3.4 Respiratory Protection Program

a. Furnish each employee required to wear a negative pressure respirator or other appropriate type with a respirator fit test at the time of initial fitting and at least every six months thereafter as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

1.3.5 Hazard Communication Program

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

1.3.6 Hazardous Waste Management

The Hazardous Waste Management Plan shall comply with applicable

requirements of federal, State, and local hazardous waste regulations and address:

a. Identification and classification of hazardous wastes associated with the work.

b. Estimated quantities of wastes to be generated and disposed of.

c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and operator and a 24-hour point of contact. Furnish two copies of State and local hazardous waste [permit applications] [permits] [manifests] [and] [EPA Identification numbers].

d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.

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

h. Cost for hazardous waste disposal according to this plan.

1.3.7 Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of Federal, State, and local authorities regarding removing, handling, storing, transporting, and disposing of lead waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.62. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply. The following [local] [and] [State] laws, ordinances, criteria, rules and regulations regarding removing, handling, storing, transporting, and disposing of lead-contaminated materials apply:

a. Ohio Department of Health, Lead Hazard Abatement, Chapter 3701-32, Ohio Administrative Code

b. Ohio Department of Health, Lead Training, Programs; Environmental Lead, analytical Laboratories, Chapter 3701-82, Ohio Administrative Code

c. Glenn Occupational Health Programs Manual, http://smad-ext.grc.nasa.gov/emo/pub/ohpm/ohpm5-lead(13).pdf

1.3.8 Pre-Construction Conference

Along with the CP, meet with the Contracting Officer to discuss in detail the hazardous waste management plan and the lead based paint removal plan,

including work procedures and precautions for the removal plan.

1.4 DESCRIPTION OF WORK

Remove all paint in the work area is considered lead based paint as needed to complete the work under this contract square feet of lead based paint.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00.98 SUBMITTAL PROCEDURES:

1.5.1 SD-03, Product

a. Vacuum filters

b. Respirators

1.5.2 SD-06, Test Reports

a. Sampling results

1.5.2.1 Occupational and Environmental Sampling Results

Submit occupational and environmental sampling results to the Contracting Officer within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.

1.5.3 SD-07, Certificates

a. Qualifications of CP

b. Testing laboratory and consultant qualifications

c. Lead based paint removal plan including CP approval (signature, date, and certification number)

d. Rental equipment notification

e. Respiratory protection program

f. Hazard communication program

g. EPA approved hazardous waste treatment or disposal facility for lead disposal

h. Hazardous waste management plan

i. Vacuum filters

j. Completed and signed hazardous waste manifest from treatment or disposal facility

k. Certification of medical examinations

l. Employee training certification

1.5.3.1 Qualifications of CP

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

1.5.3.2 Testing Laboratory and Consultant

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

1.5.3.3 Lead Based Paint Removal Plan (LBPRP)

Submit a detailed job-specific plan of the work procedures to be used in the removal of LBP. The plan shall include a sketch showing the location, size, and details of lead control areas, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include in the plan, eating, drinking, smoking and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and paint debris disposal plan, air sampling plan, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that airborne lead concentrations of 30 micrograms per cubic meter of air and baseline lead dust concentrations are not reached or exceeded outside of the lead control area. Include occupational and environmental sampling, training and strategy, sampling methodology, frequency, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan.

1.5.4 SD-08, Manufacturer's Instructions

a. Chemicals and equipment

b. Materials

c. Material safety data sheets for all chemicals

1.6 REMOVAL

1.6.1 Title to Materials

Materials resulting from demolition work, except as specified otherwise, shall become the property of the Contractor and shall be disposed of in accordance with Section 01 35 40.98, except as specified herein.

1.7 EQUIPMENT

1.7.1 Respirators

Furnish appropriate respirators approved by the Mine Safety and Health Administration (MSHA) and the National Institute for Occupational Safety

and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust. Respirators shall comply with the requirements of 29 CFR 1926.62.

1.7.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with proper disposable protective whole body clothing, head covering, gloves, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.

1.7.3 Rental Equipment Notification

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

1.7.4 Vacuum Filters

UL 586 labeled HEPA filters.

1.7.5 Equipment for Government Personnel

Furnish the Contracting Officer with two complete sets of personal protective equipment (PPE) daily, as required herein, for entry into and inspection of the paint removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, and hand protection. PPE shall remain the property of the Contractor. Respiratory protection for the Contracting Officer will be provided by the Government.

PART 2 PRODUCTS

2.1 CHEMICALS

Submit applicable Material Safety Data Sheets for all chemicals used in paint removal work. Use the least toxic product approved by the Contracting Officer.

2.2 MATERIALS

The soluble metal content and the total metal content shall not exceed values which would cause a material to be classified as a hazardous waste.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Notification

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

3.1.2 Lead Control Area Requirements

Establish a lead control area by completely enclosing with containment screens and lead caution tape the area or structure where lead based paint

removal operations will be performed.

3.1.3 Protection of Existing Work to Remain

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

3.1.4 Boundary Requirements

Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that airborne concentrations of lead will not reach 30 micrograms per cubic meter of air outside of the lead control area.

3.1.5 Furnishings

The Government will remove furniture and equipment from the building before lead based paint removal work begins.

3.1.6 Heating, Ventilating and Air Conditioning (HVAC) Systems

Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6 mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area. Provide temporary HVAC system for areas in which HVAC has been shut down outside the lead control area.

3.1.7 Decontamination Shower Facility

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

3.1.8 Mechanical Ventilation System

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

b. To the extent feasible, use fixed local exhaust ventilation connected to HEPA filters or other collection systems, approved by the CP. Local exhaust ventilation systems shall be designed, constructed, installed, and maintained in accordance with ANSI Z9.2.

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

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

3.1.9 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

3.1.10 Warning Signs

Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

3.2 WORK PROCEDURES

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

3.2.1 Personnel Exiting Procedures

Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn during the work day:

a. Vacuum themselves off.

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

c. Wash hands, face and exposed skin.

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

3.2.2 Air and Wipe Sampling

Air sample for lead in accordance with 29 CFR 1926.62 and as specified herein. Air and wipe sampling shall be directed or performed by the CP.

a. The CP shall be on the job site directing the air and wipe sampling and inspecting the lead based paint removal work to ensure that the requirements of the contract have been satisfied during the entire lead based paint removal operation.

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

c. Submit results of air samples, signed by the CP, within 72 hours after the air samples are taken. Notify the Contracting Officer immediately of exposure to lead at or in excess of the action level of 30 micrograms per cubic meter of air outside of the lead control area.

d. Before any work begins, collect and analyze baseline wipe samples in accordance with methods defined in federal, State, and local standards inside and outside of the physical boundary to assess the degree of dust contamination in the facility prior to lead

based paint removal.

3.2.2.1 Air Sampling During Paint Removal Work

Conduct area air sampling daily, on each shift in which lead based paint removal operations are performed, in areas immediately adjacent to the lead control area. Sufficient area monitoring shall be conducted to ensure unprotected personnel are not exposed at or above 30 micrograms per cubic meter of air. If 30 micrograms per cubic meter of air is reached or exceeded, stop work, correct the conditions(s) causing the increased levels. Notify the Contracting Officer immediately. Determine if condition(s) require any further change in work methods. Removal work shall resume only after approval is given by the CP and the Contracting Officer. For outdoor operations, at least one sample on each shift shall be taken on the downwind side of the lead control area.

3.2.3 Lead Based Paint Removal

Manual or power sanding of interior and exterior surfaces is not permitted. Provide methodology for removing LBP in work plan. Remove paint within the areas designated on the drawings in order to completely expose the substrate. Take whatever precautions necessary to minimize damage to the underlying substrate.

Avoid flash rusting or other deterioration of the substrate. Provide surface preparations for painting in accordance with Section 09 90 00, "PAINTS AND COATINGS".

Select paint removal processes to minimize contamination of work areas with lead-contaminated dust or other lead-contaminated debris/waste. Describe this paint removal process in the lead based paint removal plan. Perform manual wet sanding and scraping to the maximum extent feasible.

3.2.3.1 Indoor Lead Paint Removal

Perform manual or mechanical paint removal in lead control areas using negative pressure enclosures with HEPA filtered exhaust and power actuated locally exhausted paint removal tools. Collect paint residue for disposal in accordance with EPA, State, and local requirements.

3.2.3.2 Outdoor Lead Paint Removal

Perform outdoor LBP removal as indicated in federal, State, and local regulations and in the work plan.

3.2.3.3 Air and Wipe Sampling After Paint Removal

After the visual inspection, collect air samples inside and outside the lead control area to determine the airborne levels of lead inside and outside the work area. Collect wipe samples according to the HUD protocol to determine the lead content of settled dust and dirt in micrograms per square foot of surface area.

3.2.4 Cleanup and Disposal

3.2.4.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of paint chips and dust. Restrict the spread of dust and debris; keep waste from

being distributed over the work area. Do not dry sweep or use compressed air to clean up the area. At the end of each shift and when the paint removal operation has been completed, clean the area of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the CP. Reclean areas showing dust or residual paint chips or debris. After visible dust, chips and debris is removed, wet wipe and HEPA vacuum all surfaces in the work area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The CP shall then certify in writing that the area has been cleaned of lead contamination before restarting work.

3.2.4.2 Certification

The CP shall certify in writing that the final air samples collected inside and outside the lead control area are less than 30 micrograms per cubic meter of air [and that the surface wipe sample results collected inside and outside the work area are less than 100 micrograms per square foot on uncarpeted floors, less than 500 micrograms per square foot on interior window sills and less than 800 micrograms per square footon window troughs]; the respiratory protection used for the employees was adequate; the work procedures were performed in accordance with 29 CFR 1926.62 and 40 CFR 745; and that there were no visible accumulations of lead based paint and dust left in the work site. Do not remove the lead control area or roped off boundary and warning signs prior to the Contracting Officer's acknowledgement of receipt of the CP certification.

3.2.4.3 Disposal

a. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing which may produce airborne concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62 and 40 CFR 261. Dispose of lead-contaminated waste material at an EPA or State approved hazardous waste treatment, storage, or disposal facility off Government property.

b. Store waste materials in U.S. Department of Transportation (49 CFR 178) approved 55 gallon drums. Properly label each drum to identify the type of waste (49 CFR 172) and the date the drum was filled. The Contracting Officer or an authorized representative will assign an area for interim storage of waste-containing drums. Do not store hazardous waste drums in interim storage longer than 90 calendar days from the date affixed to each drum.

c. Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

3.2.5 Disposal Documentation

Submit written evidence that the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA and State or local regulatory agencies. Submit one copy of the completed manifest, signed and dated by the initial transporter in accordance with 40 CFR 262.

3.2.6 Payment for Hazardous Waste

Payment for disposal of hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility certifying the amount of lead-containing materials delivered is returned and a copy is furnished to the Government.

-- End of Section --

SECTION 05 05 23

WELDING, STRUCTURAL
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.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360	(2010) Specification for Structural Steel Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0M/A3.0	(2010) Standard Welding Terms and Definitions
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
AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel
AWS D14.1/D14.1M	(2005) Specification for Welding Industrial and Mill Cranes and Other Material Handling Equipment
AWS D14.4/D14.4M	(2012) Specification for Welded Joints for Machinery and Equipment
AWS Z49.1	(2005) Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM E165/E165M	(2012) Standard Practice for Liquid Penetrant Examinationfor General Industry
ASTM E709	(2008) Standard Guide for Magnetic Particle Examination

1.2 DEFINITIONS

Definitions of welding terms are in accordance with AWS A3.0M/A3.0. The following classifications, Class 3 (to Class 6 class, indicate the

project's class(es) of weld joints.

1.2.1 Class 3 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would not affect the efficiency of a system nor create a hazard to personnel. Class 3 weld joints are connections of secondary members not subject to dynamic action and/or low stressed miscellaneous applications.

1.2.2 Class 4 Weld Joints

This covers weld joints applicable to welding reinforcing steel to primary structural members.

1.2.3 Class 5 Weld Joints

This covers weld joints applicable to welding concrete reinforcing steel splices (prestressing steel excepted), steel connection devices, and inserts and anchors required in concrete construction.

1.2.4 Class 6 Weld Joints

This covers plug and slot weld joints as applicable to the requirements of the project's code(s).

1.3 SYSTEM DESCRIPTION

Conform the design of welded connections to AISC 360, unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Perform all testing at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.3.1 Pre-erection Conference

Hold a pre-erection conference prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (which the Contractor shall develop and submit for all welding, including welding done using pre-qualified procedures). Mandatory attendance is required by all Contractor's welding production and inspection personnel and appropriate Government personnel. Include as items for discussion: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and ultrasonic; welding schedule; fabrication of mock-up model; and other items deemed necessary by the attendees.

1.3.2 Mock-up Model

Perform first the field-welded connection designated as the mock-up model

on the drawings. All welders, qualified and designated to perform field-welded groove joints, shall be present during the welding of the mock-up model connections and each one shall perform a part of the welding. Simulate with the mock-up test all physical and environmental conditions that will be encountered during the welding of all groove joints. Execute all inspection procedures required for groove welded joints, including NDE tests, on the mock-up model. All Contractor inspection and testing personnel designated to perform QC of groove welded joints shall be present during the welding of the mock-up model and each one shall perform the inspection procedures to be performed on production welding of these joints. This mock-up model connection represents the standard of performance, both for the welding and inspection procedures used and the results to be achieved in the production welding for these groove welded joints.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Information only. 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:

SD-03 Product Data

Welding Procedure Qualifications; G
Welder, Welding Operator, and Tacker Qualification
Inspector Qualification
Previous Qualifications
Pre-qualified Procedures

SD-06 Test Reports

Quality Control
Nondestructive Examination

SD-07 Certificates

Certified Welding Procedure Specifications (WPS)
Certified Brazing Procedure Specifications (BPS)
Certified Procedure Qualification Records (PQR)
Certified Welder Performance Qualifications (WPQ)
Certified Brazer Performance Qualifications (BPQ)

1.5 QUALITY ASSURANCE

Except for pre-qualified (in accordance with AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding shall record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform welding procedure qualifications to AWS D1.1/D1.1M and to the specifications in this section. Submit for approval copies of the welding procedure specification and the results of the procedure qualification test records for each type of welding which requires procedure qualification and the welder, welding operator, or tacker qualification test records.. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Annex M of AWS D1.1/D1.1M. Individually identify and clearly

reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.5.1 General Requirements

To perform this work provide an organization certified in the following: American Institute of Steel Construction (AISC) Quality Certification Program Category Category I Conventional Steel Structures.

a. For Structural Projects, provide documentation of the following:

(1) Component Thickness 1/8 inch and greater: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.1/D1.1M.

(2) Component Thickness Less than 1/8 inch: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.3/D1.3M.

(3) Reinforcing Steel: Qualification documents (WPS, PWR, and WPQ) in accordance with AWS D1.4/D1.4M.

b. For other applications, provide documentation of the following:

(1) Submit for approval to the Contracting Officer two copies of Certified Welding Procedure Specifications (WPS), Certified Brazing Procedure Specifications (BPS) and Certified Procedure Qualification Records (PQR) within fifteen calendar days after receipt of Notice to Proceed.

(2) Cranes: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.1/D14.1M.

(3) Submit for approval to the Contracting Officer two copies of Certified Welder Performance Qualifications (WPQ)and Certified Brazer Performance Qualifications (BPQ) within fifteen calendar days prior to any employee welding on the project material.

(4) Machinery: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.4/D14.4M.

1.5.2 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without re-qualification, upon receipt of the test results, if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.3 Pre-qualified Procedures

No pre-qualified welding procedures are allowed. Qualify the welding procedures and welders by tests prescribed in the applicable code or specification not withstanding the fact the code or specification may allow pre-qualified procedures.

1.5.4 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, revise and re-qualify the procedure specification, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, submit all test results, including those of test welds that failed to meet the requirements, with the welding procedure.

1.5.5 Welder, Welding Operator, and Tacker Qualification

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.5.5.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.5.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. State in the certification the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 3 copies.

1.5.5.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.

d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he/she is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker is required to pass the prescribed tack welding test.

1.5.6 Symbols and Safety

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated. Safe welding practices and safety precautions during welding shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

Provide all welding equipment, electrodes, welding wire, and fluxes capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1/D1.1M.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360. When AWS D1.1/D1.1M and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M govern.

3.1.2 Identification

Identify all welds in one of the following ways:

a. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.

b. Identify all work performed by each welder, welding operator, or

tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers is not allowed.

3.2 QUALITY CONTROL

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. Perform visual inspections to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M, ASTM E165/E165M, ASTM E709, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," are acceptable. Submit a quality assurance plan and records of tests and inspections.

3.3 STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Perform nondestructive testing by visual inspection

3.3.1 Nondestructive Examination

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment. Submit all records of nondestructive examination in accordance with paragraph "Acceptance Requirements".

3.3.2 Destructive Tests

Make all repairs when metallographic specimens are removed from any part of a structure. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds shall meet the inspection requirements for the original welds. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

-- End of Section --

SECTION 05 12 00

STRUCTURAL STEEL
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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 201	(2006) AISC Certification Program for Structural Steel Fabricators
AISC 303	(2010) Code of Standard Practice for Steel Buildings and Bridges
AISC 325	(2011) Steel Construction Manual
AISC 326	(2009) Detailing for Steel Construction
AISC 360	(2010) Specification for Structural Steel Buildings
AISC DESIGN GUIDE 10	(1997) Erection Bracing of Low-Rise Structural Steel Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2012; Errata 2011) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B46.1	(2009) Surface Texture, Surface Roughness, Waviness and Lay

ASTM INTERNATIONAL (ASTM)

ASTM A108	(2007) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
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 A242/A242M	(2004; R 2009) Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A276	(2010) Standard Specification for Stainless Steel Bars and Shapes
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 A490	(2012) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
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 A588/A588M	(2010) Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A6/A6M	(2012) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A668/A668M	(2004; R 2009) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

ASTM A992/A992M	(2011) Standard Specification for Structural Steel Shapes
ASTM B695	(2004; R 2009) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C1107/C1107M	(2011) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C827/C827M	(2010) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM F436	(2011) Hardened Steel Washers
ASTM F844	(2007a) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F959	(2009) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting of Steel
SSPC PS 13.01	(1982; E 2004) Epoxy Polyamide Painting System
SSPC Paint 25	(1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

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

29 CFR 1926.756	Steel Erection; Beams and Columns

1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with AISC 360 except as modified in this contract.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are For information only. 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:

SD-02 Shop Drawings

Erection Plan, including description of temporary supports : G

Fabrication drawings including description of connections; G

SD-03 Product Data

Shop primer

Welding electrodes and rods

Load indicator washers

Non-Shrink Grout

Load indicator bolts

Include test report for Class B primer.

SD-06 Test Reports

Class B coating

Bolts, nuts, and washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

SD-07 Certificates

Steel

Bolts, nuts, and washers

Welding procedures and qualifications

1.4 AISC QUALITY CERTIFICATION

Work shall be fabricated in an AISC certified Category Std fabrication plant.

1.5 SEISMIC PROVISIONS

The structural steel system shall be provided in accordance with AISC 341.

1.6 QUALITY ASSURANCE

1.6.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326 and AISC 325. Fabrication drawings shall not be reproductions of contract drawings. Sign and seal fabrication drawings by a professional engineer registered in the State where the project is located. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes,

and cuts. Double connections that require an erection seat to comply with OSHA 29 CFR 1926.756(c)(1) shall be shown on the shop drawings, reviewed and approved by the structural engineer of record. Use AWS A2.4 standard welding symbols. Member substitutions of details shown on the contract drawings shall be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.6.2 Certifications

1.6.2.1 Overhead, Top Running Crane Rail Beam

Submit written field survey results for overhead, top running crane rail beam verifying tolerance alignment requirements, areas out of tolerance and proposed corrective measures.

1.6.2.2 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing.

1.6.2.3 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests.

Conform to all requirements specified in AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

ASTM A36/A36M.

2.1.2 High-Strength Structural Steel

2.1.2.1 Quenched and Tempered Alloy Steel

2.1.3 Weathering Structural Steel

ASTM A242/A242M, Type 1; ASTM A588/A588M.

2.1.4 Structural Grade Carbon-Manganese Steel

ASTM A529/A529M, high strength carbon-manganese steel of structural quality.

2.1.5 Structural Shapes for Use in Building Framing

Wide flange shapes, ASTM A992/A992M.

2.1.6 Structural Steel Tubing

2.1.7 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B.

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Structural Steel , Steel Pipe

2.2.1.1 Bolts

ASTM A307, Grade A. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.1.2 Nuts

ASTM A563, Grade and Style for applicable ASTM bolt standard recommended.

2.2.1.3 Washers

ASTM F844 washers for ASTM A307 bolts, and ASTM F436 washers for ASTM A325 and ASTM A490 bolts.

2.2.2 High-Strength Structural Steel and Structural Steel Tubing

2.2.2.1 Bolts

ASTM A325, Type 1 ASTM A490, Type 1 or 2.

2.2.2.2 Nuts

ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

2.2.2.3 Washers

ASTM F436, plain carbon steel.

2.2.3 Weathering Structural Steel

2.2.3.1 Bolts

ASTM A325, Type 3; ASTM A490, Type 3.

2.2.3.2 Nuts

ASTM A563, heavy hex style, Grade DH3, except Grade C3 may be furnished for ASTM A325 bolts.

2.2.3.3 Washers

ASTM F436, weathering steel.

2.2.4 Foundation Anchorage

2.2.4.1 Anchor Bolts

Stainless steel ASTM A193/A193M.

2.2.4.2 Anchor Nuts

ASTM A563, Grade A, hex style. Stainless steel ASTM A193/A193M.

2.2.4.3 Anchor Washers

ASTM F844. Stainless steel Type 316 conforming to ASTM A276.

2.2.4.4 Anchor Plate Washers

ASTM A36/A36M Stainless steel Type 316 conforming to ASTM A276.

2.2.5 Load Indicator Washers

ASTM F959. Provide ASTM B695, Class 50, Type 1 galvanizing.

2.2.6 Load Indicator Bolts

ASTM A325, Type 1; ASTM A490, Type 1, with a manufactured notch between the bolt tip and threads. The bolt shall be designed to react to the opposing rotational torques applied by the installation wrench, with the bolt tip automatically shearing off when the proper tension is obtained.

2.2.7 Self-Locking Nuts

Provide nuts with a locking pin set in the nut. The locking pin shall slide along the bolt threads, and by reversing the direction of the locking pin, the nut shall be removed without damaging the nut or bolt. Provide stainless steel locking pins.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.

2.3.2 Non-Shrink Grout

ASTM C1107/C1107M, with no ASTM C827/C827M shrinkage. Grout shall be nonmetallic.

2.3.3 Welded Shear Stud Connectors

AWS D1.1/D1.1M.

2.3.4 Pins and Rollers

ASTM A668/A668M, Class C, D, F, or G; ASTM A108, Grades 1016 to 1030. Provide as specified in AASHTO HB-17, Division II, Sections 10.26 and 10.27, except provide pins in lengths to extend a minimum of 0.25 inch beyond the outside faces of the connected parts.

2.4 SHOP PRIMER

SSPC Paint 25, (alkyd primer) or SSPC PS 13.01 epoxy-polyamide, green primer (Form 150) type 1, except provide a Class B coating in accordance with AISC 325 for slip critical joints. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

2.5 GALVANIZING

ASTM A123/A123M or ASTM A153/A153M, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

2.6.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded . Do not locate match markings in areas that will decrease member strength or cause stress concentrations.

2.6.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, surfaces to receive epoxy coatings,surfaces designed as part of a composite steel concrete section, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the Contracting Officer.

2.6.2.1 Cleaning

SSPC SP 6/NACE No.3, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.6.2.2 Primer

Apply primer to a minimum dry film thickness of 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

2.6.3 Epoxy Coated Surfaces

Surfaces to receive epoxy coatings shall be cleaned and prepared in accordance with the manufacturer's recommendations, and as specified in Section 07 81 00 SPRAY-APPLIED FIREPROOFING.

2.6.4 Surface Finishes

ASME B46.1 maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

2.7 DRAINAGE HOLES

Adequate drainage holes shall be drilled to eliminate water traps. Hole diameter shall be 1/2 inch and location shall be indicated on the detail drawings. Hole size and location shall not affect the structural integrity.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC 325. Fabrication and assembly shall be done in the shop to the greatest extent possible.

Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A6/A6M.

Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with endorsement "P" of AISC 201 and primed with the specified paint.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the Contracting Officer.

3.2 ERECTION

a. Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of endorsement F of AISC 201. Erection plan shall be reviewed, stamped and sealed by a licensed structural engineer.

b. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), the erection plan shall conform to AISC 303 and the structure shall be erected in accordance withAISC DESIGN GUIDE 10.

c. Do not splice truss top and bottom chords except as approved by the Contracting Officer. Chord splices shall occur at panel joints at approximately the third point of the span. The center of gravity lines of truss members shall intersect at panel points unless otherwise approved by the Contracting Officer. When the center of gravity lines do not intersect at a panel point, provisions shall be made for the stresses due to eccentricity. Cumber of trusses shall be 1/8 inch in 10 feet unless otherwise indicated.

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.2.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.3 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt and pin holes perpendicular to the surface of the member. Holes shall not be cut or enlarged by burning. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.3.1 Common Grade Bolts

ASTM A307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.3.2 High-Strength Bolts

ASTM A325 and ASTM A490 bolts shall be fully tensioned to 70 percent of their minimum tensile strength. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.3.2.1 Installation of Load Indicator Washers (LIW)

ASTM F959. Where possible, the LIW shall be installed under the bolt head and the nut shall be tightened. If the LIW is installed adjacent to the turned element, provide a flat ASTM F436 washer between the LIW and nut when the nut is turned for tightening, and between the LIW and bolt head when the bolt head is turned for tightening. In addition to the LIW, provide flat ASTM F436 washers under both the bolt head and nut when ASTM A490 bolts are used.

3.4 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the Contracting Officer.

3.5 WELDING

Grind exposed welds smooth as indicated. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

The Contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

3.5.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

3.6 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.6.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.7 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.8 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.8.1 Welds

3.8.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

3.8.1.2 Nondestructive Testing

AWS D1.1/D1.1M. Test locations shall be selected by the Contracting Officer. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the Contracting Officer. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

3.8.2 Load Indicator Washers

3.8.2.1 Load Indicator Washer Compression

Load indicator washers shall be tested in place to verify that they have been compressed sufficiently to provide the 0.015 inch gap when the load indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.005 inch gap when the load indicator washer is placed

under the turned element, as required by ASTM F959.

3.8.3 High-Strength Bolts

3.8.3.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 2 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 360, depending on bolt size and grade. The bolt tension shall be developed by tightening the nut. A representative of the manufacturer or supplier shall be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements.

3.8.3.2 Inspection

Inspection procedures shall be in accordance with AISC 360 . Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

The Contractor shall inspect calibration of torque wrenches for high-strength bolts.

3.8.3.3 Testing

The Government has the option to perform nondestructive tests on 5percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The Contractor shall allow access for the Government to perform the tests. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Contracting Officer. If more than 10percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested at the Contractor's expense. Retest new bolts after installation at the Contractor's expense.

-- End of Section --

SECTION 09 90 00.00 98

PAINTING AND COATING
03/08

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. 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 00.98 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items. Data shall include detailed analysis of each coating material required, with constituents measured as percentages of the total weight of coating.

Inhibitive Metal Primer, G
Pigmented Sealer, G
Latex Block Filler, G
Alkali Resistant Primer, G
Enamel Undercoat, G
Exterior Wood Primer, G
Acrylic Latex, G
Acrylic Epoxy, G

SD-04 Samples

Manufacturer's Standard Color Charts shall be submitted in accordance with paragraph entitled, "Manufacturer's and Materials," of this section.

SD-07 Certificates

A Safety Plan shall be submitted in accordance with paragraph entitled, "General," of this section.

SD-08 Manufacturer's Instructions

Manufacturer's instructions shall be submitted for architectural coatings including details of thinning, mixing, handling, and application, in accordance with paragraph entitled, "General," of this section.

1.2 CONTRACTOR PERSONNEL QUALIFICATION

Personnel assigned to the work shall be certified by the Contractor to have had adequate previous experience in the successful application of paints and coatings similar to those specified.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered in their original, unbroken containers

bearing the manufacturer's name and product identification. Containers breached by rough handling shall be removed from the site, together with their contents.

Paint materials, thinners, and cleaners shall be stored in tightly closed containers in a covered, well-ventilated area where they will not be exposed to excessive heat, sparks, flame, or direct sunlight. Water-based materials shall be protected against freezing.

PART 2 PRODUCTS

2.1 MANUFACTURER'S AND MATERIALS

Manufacturer's Standard Color Charts shall be submitted showing manufacturer's recommended finish colors. Three color chips of each color and gloss scheduled shall also be submitted.

The following are suggested paint manufacturers and their products. Other paint manufacturers' products of equal quality will be considered when submitted and approved by the Contracting Officer.

2.1.1 EXTERIOR PAINTING SCHEDULE

Concrete and Masonry (Other Than Concrete Masonry Units) (Satin): (Latex system). Similar to MPI EXT 3.1A.

1. Finish Coats: MPI Product Number 15. Satin Latex, (5-19 units at 60 degrees F.), 1.4 to 1.6 mils DFT/coat.
2. Surfaces: Walls, ceilings, columns, soffits.
3. Sherwin Williams: A100 Satin
4. PPG: Sun-Proof
5. Benjamin Moore: Moorcraft

Concrete Masonry Units (Semi-Gloss): (Latex System), similar to MPI EXT 4.2A.

1. Block Filler: MPI Product Number 4. High Solids, Pigmented Block Filler.
2. Finish Coats: MPI Product Number 11. Latex, Semi-Gloss (20-30 units at 60 degrees F.), 1.3 to 1.5 mils DFT/Coat.
3. Surfaces: Exterior Block (Normal Exposure).
4. Sherwin Williams: Loxon Block Surfacer; Top-Coat, A100 Gloss.
5. PPG: Primer, Speedhide; Top-Coat S/G House Paint
6. ICI: Devoe Bloxfill; Top-Coat, Ultra-Hide

Metal - Ferrous (Semi-Gloss): (Alkyd Acrylic System).

1. Primer: MPI Product Number 79. Primer, Alkyd, Anti-Corrosive for Metal.
2. Finish Coats: MPI Product 153. 100 percent Acrylic, Waterborne, Semi-Gloss (30-40 units at 60 degrees F.), 3.0 mils DFT/coat.
3. Surfaces: Miscellaneous ferrous metal.
4. Sherwin Williams: Primer, Kem Kromik; Top-Coat, DTM Semi-Gloss.
5. Benjamin Moore: Primer, Industrial Alkyd Metal Primer; Top-Coat, Industrial Maint. Coating D.T.M.
6. CI: Primer, Devguard; Top-Coat, Dulux.

Metal - Galvanized (Semi-Gloss): (Acrylic Latex System), similar to MPI EXT 5.3H.

1. Primer Coat: MPI Product Number 134.
2. Finish Coats: MPI Product Number 11. Latex Exterior Semi-Gloss (30-40 units at 60 degrees F.), 3.0 mils DFT/coat.
3. Surfaces: Exterior lintels.
4. Sherwin Williams: Primer, DTM Acrylic Primer/Finish; Top-Coat, A100 Gloss.
5. PPG: Primer, Interior/Exterior WB Industrial Primer; Top-Coat, S/G Latex House Paint.
6. ICI: Primer, Devflex WB DTM Primer Finish; Top-Coat, Ultra-Hide.

Metal - Heat Resistant: (Maximum Temperature 1,000 degrees F.) (VOC 650), similar to MPI #22.

1. Primer: Silicone Alkyd, .75 mils DFT/coat.
2. Finish Coats: Silicone Alkyd, Aluminum Bright, .75 - 1.0 mils DFT/coat.
3. Surfaces: Stacks with temperature above 200 degrees F.
4. Sherwin Williams: Kem Hi-Temp 1200
5. PPG: Amercoat 878
6. ICI: Hi-Heat Silicone Coating"

2.1.2 INTERIOR PAINTING SCHEDULE

Concrete Surfaces (Semi-Gloss): (Latex), similar to MPI INT 3.1M.

1. Finish Coats: MPI Product Number 147, Latex Semi-Gloss Enamel (34-45 units at 60 degrees F.), 2.0 - 2.4 mils DFT/coat.
2. Surfaces: Concrete walls and concrete bases.
3. Sherwin Williams; Harmony
4. PPG; Pure Performance
5. Benjamin Moore; Pristine Eco Spec

Concrete Surfaces (Gloss): (Epoxy System), similar to MPI Product Number 31.

1. Primer: Per manufacturer's recommendation.
2. Finish Coats: Epoxy (Gloss) 2.5 - 3.0 mils DFT/coat.
3. Surfaces: Floors, stairs, striping on floors.
4. Sherwin Williams; Armorseal Rexthane
5. Benjamin Moore; Moisture Cured Urethane
6. ICI; Armabrite

Concrete Masonry Surfaces (Semi-Gloss): (Vinyl Acrylic Latex System), similar to MPI INT 4.2E.

1. Primer: MPI Product Number 4, Vinyl Acrylic Block Filler.
2. Finish Coats: MPI Product Number 147, Vinyl Acrylic Semi-Gloss Enamel (25-35 units at 60 degrees F.), 1.5 DFT/coat.
3. Surfaces: New masonry walls, graphics (do not use in high humidity areas).
4. Sherwin Williams; Primer: PrepRite Block Filler, Topcoat: Harmony Semi Gloss
5. PPG; Primer: Speedhide, Topcoat: Pure Performance
6. ICI; Devoe Coating Bloxfil Acrylic Block Filler, Topcoat:

Dulux Lifemaster

Concrete Masonry Surfaces (Gloss): (Water Based Epoxy - High Humidity), similar to MPI INT 4.2G.

1. Primer: MPI Product Number 116, Block Filler Epoxy.
2. Finish Coats: MPI Product 77, Epoxy (75-95 units at 60 degrees F.) 10.0- 20.0 mils DFT/coat.
3. Surfaces: Showers and high humidity areas.
4. Sherwin Williams; Primer Kem Cati-Coat Epoxy Filler Sealer., Top-Coat: Tile-Clad High Solid HS.
5. PPG; Primer: Aquapon, Top-Coat: As recommended by manufacturer.
6. Benjamin Moore: Primer as recommended by manufacturer, Top-Coat Polyamide Epoxy Gloss Coating

Metal - Ferrous (Semi-Gloss): (Alkyd Enamel System, Maximum VOC content 450 grams/liter), similar to MPI INT 5.1E.

1. Primer: MPI Product Number 79, Primer, Alkyd, Anti-Corrosive for Metal, 3 mils DFT/coat
2. Finish Coats: MPI Product Number 47, Alkyd Enamel, Semi-Gloss (40-50 units at 60 degrees F.), 3.0 mils DFT/coat.
3. Surfaces: Hollow metal doors, frames, door mullions, railings, ferrous metal surfaces.
4. Sherwin Williams; Primer:Kem Kromik, Top-Coat: ProMar 200 Alkyd Semi-Gloss.
5. Benjamin Moore; Primer: Industrial Alkyd Metal Primer, Top-Coat: Architectural Coatings Satin Impervo Finish Enamel.
6. ICI; Primer Devguard, Top-Coat: Dulux Ultra

Exposed Structure - Ferrous (Flat): (Waterborne), similar to MPI INT 5.1C.

1. Primer; MPI Product Number 79.
2. Finish Coats: MPI Product Number 118. Acrylic Waterborne (white) flat (0-10 units at 60 degrees F.), 1 mil DFT/coat.
3. Surfaces: Exposed metal decking, trusses, structural steel, metal joists.
4. Sherwin Williams: Primer, Kem Kromik; Top Coat, Waterborne Acrylic Dryfall.
5. Benjamin Moore: Industrial, Alkyd Metal Primer; Top Coat MooreSpec Latex D.T.M. Dryfall Coating.
6. ICI: Primer, Devguard; Top Coat, Spraymaster Aquacrylic Dryfall Flat.

PART 3 EXECUTION

3.1 GENERAL

A Safety Plan shall be submitted for architectural coating systems in accordance with OSHA regulations.

Manufacturer's recommendations for surface preparation, thinning, mixing, handling, and application shall be considered a part of this specification.

3.2 PROTECTION OF FACILITIES

Contractor shall remove and reinstall or provide acceptable protection for hardware, accessories, lighting and electrical components, factory-finished materials, plumbing fixtures and fittings, and any other materials that may become splattered or damaged by the painting work.

3.3 SURFACE PREPARATION

3.3.1 General Requirements

Surfaces shall be clean, dry, and free from contaminants and foreign matter. Mildew and chalking shall be removed and the surface thoroughly sterilized. Chipped, peeling, or blistered paint shall be removed and the surface spot primed. Hard glossy surfaces shall be dulled and roughened to ensure proper adhesion.

3.3.2 Ferrous Metal

Surfaces shall be free from dirt, oil, grease, wax, and other contaminants. Heavy rust and loose mill scale shall be removed by hand, power tool, or blast cleaning.

3.3.3 Galvanized Steel

Surfaces shall be cleaned of all contaminants using a solvent such as lacquer thinner or xylol.

After cleaning, the surface shall be etched with a phosporic acid pre-treatment solution.

3.3.4 Aluminum

Surfaces shall be clean, dry, and free from oil and grease. Oxide film and corrosion shall be removed by hand or power tool cleaning.

3.3.5 Wood

Surfaces shall be clean, dry, smooth, and free from oil, grease, and dirt. Knots shall be sealed with a mixture of equal parts of shellac and alcohol. Nail holes, cracks, and other defects shall be filled with plastic wood or putty. Concealed surfaces shall be back-primed before installation.

3.3.6 Masonry

Surfaces shall be free from dirt, oil, grease, wax, form-release compounds, laitance, and other contaminants. Cracks, voids, and other major surface imperfections shall be filled with mortar.

3.3.7 Plaster and Drywall

Surfaces shall be clean and dry. Cracks and other surface imperfections shall be filled with spackling compound and sanded smooth.

3.4 MIXING AND APPLICATION

3.4.1 General Procedures

No exterior painting shall be allowed in rainy weather or when rain is imminent. No paints or coatings shall be applied when the temperature or humidity is outside the limits recommended by the manufacturer.

Paints and coatings shall be applied by brush, roller, or airless spray.

Each coat of material applied shall be free from runs, sags, bubbles, foreign contaminants, variations in color, gloss, and texture, dry overspray, brush and roller marks, holidays (missed areas), or other evidence of poor application.

Paints and coatings shall be thoroughly worked into corners and crevices.

Newly painted surfaces shall be adequately protected from damage.

3.4.2 Procedures

There shall be at least three coats of paint (primer and two finish coats) applied in accordance with the manufacturer's instructions, unless otherwise noted.

Coatings shall be applied as follows:

Material shall be thoroughly stirred to produce a uniform mixture.

Material shall be thinned for workability and improved spray characteristics, but only according to the manufacturer's instructions.

Each coat shall be applied uniformly at the minimum wet-film thickness specified by the manufacturer.

Special attention shall be given when coating sharp edges, corners, and crevices to ensure complete coverage.

Finish coats shall show good hiding characteristics and uniform appearance.

3.5 ACCEPTANCE PROVISIONS

3.5.1 Inspection

Contractor shall provide qualified personnel for inspection of his work to ensure that the requirements of this section have been fulfilled.

3.5.2 Correction

Spot-painting to correct damaged surfaces will be allowed only when touchup area blends into the surrounding finish. Otherwise, the entire area shall be recoated. Touchup shall be accomplished using the same method of application as was used to apply the original material.

3.6 PROTECTION

"WET PAINT" signs shall be posted to indicate newly painted surfaces.

-- End of Section --

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GENERAL ELECTRICAL PROVISIONS
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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z535.1	(2002) Standard for Safety Color Code

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005) National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MS MIL-T-704	(Rev K) Treatment and Painting of Material

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-59214	(2004) Junction Box: Extension, Junction Box; Cover, Junction Box (Steel, Coated With Corrosion-Resistant Finish)

UNDERWRITERS LABORATORIES (UL)

UL Elec Const Dir	(2005) Electrical Construction Equipment Directory

1.2 SUBMITTALS

Not Used

1.3 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

It is the intent of these specifications and the contract drawings to provide a complete and workable facility.

Design drawings are diagrammatic and do not show all offsets, bends, elbows, or other specific elements that may be required for proper installation of the work. Such work shall be verified at the site.

Additional bends and offsets, and conduit as required by vertical and horizontal equipment locations or other job conditions, shall be provided to complete the work at no additional cost to the Government.

Except where shown in dimensional detail, the locations of switches, receptacles, lights, motors, outlets, and other equipment shown on plans are approximate. Such items shall be placed to eliminate interference with ducts, piping, and equipment. Exact locations shall be determined in the field. Door swings shall be verified to ensure that light switches are properly located.

Equipment sizes indicated are minimum. Before installing any wire or conduit, the Contractor shall obtain the exact equipment requirements and shall install wire, conduit, disconnect switches, motor starters, heaters, circuit breakers, and other items of the correct size for the equipment actually installed. Wire and conduit sizes shown on the drawings shall be taken as a minimum and shall not be reduced without written approval.

1.4 CODES AND STANDARDS

Equipment design, fabrication, testing, performance, and installation shall, unless shown or specified otherwise, comply with the applicable requirements of NFPA 70 and IEEE C2 to the extent indicated by the references.

1.5 COORDINATION

Installation of the electrical work shall be coordinated with the work of other trades.

1.6 APPROVAL REQUIREMENTS

Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories (UL), the label of, or listing with re-examination, in UL Elec Const Dir will be acceptable as sufficient evidence that the items conform to the requirements.

Where materials or equipment are specified to be constructed or tested in accordance with the standards of NEMA, ANSI, ASTM, or other recognized standards, a manufacturer's certificate of compliance indicating complete compliance of each item with the applicable NEMA, ANSI, ASTM, or other commercial standards specified will be acceptable as proof of compliance.

1.7 PREVENTION OF CORROSION

Metallic materials shall be protected against corrosion. Equipment enclosures shall be given a rust-inhibiting treatment and the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09 96 00.00 40 HIGH- PERFORMANCE COATINGS. Aluminum shall not be used in contact with earth or concrete. Dissimilar metals in intimate contact shall be protected by approved fittings, barrier material, and treatment. Ferrous metals such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A 123/A 123M for exterior locations and cadmium-plated in conformance with FS A-A-59214 for interior locations.

1.8 HAZARDOUS AREA

Electrical work within any hazardous location shall meet the applicable requirements of NFPA 70, Chapter 5, Articles 500 through 517. The following definitions apply:

Explosionproof: A receptacle, fixture, device, or equipment enclosure that is designed to withstand explosion of a specified liquid, gas, vapor, or dust within the enclosure and to prevent the ignition of a specified gas, vapor, or dust surrounding the enclosure by sparks, flashes, or explosions of the specified liquid, gas, vapor, or dust that may occur within the enclosure. Enclosure shall be capable of operating at an external temperature that will not ignite a surrounding flammable atmosphere.

Hazardous location: An area where ignitable vapors or dust may cause a fire or explosion created by energy emitted from lighting or other electrical equipment or by electrostatic generation.

NFPA 70, Article 500-2 lists chemical atmospheres by groups A, B, C, and D. In addition, although not defined as a hazardous material by the NEC, oxygen concentrations (liquid and gaseous) are considered to provide a hazard because of the increased flammability of materials exposed to oxygen. Therefore, oxygen concentrations shall be classified under Group D.

PART 2 PRODUCTS

2.1 IDENTIFICATION PLATES

Identification plates shall be 3-layer white-black-white, engraved to show black letters on a white background. Letters shall be uppercase. Identification plates 1-1/2 inches high and smaller shall be 1/16-inch thick with engraved lettering 1/8-inch high. Identification plates larger than 1-1/2 inches high shall be 1/8-inch thick with engraved lettering not less than 3/16-inch high. Identification plates having edges of 1-1/2 inches high and larger shall be beveled.

2.2 WARNING SIGNS

Each item of electrical equipment operating at 480 volts and above shall be provided with conspicuously located warning signs conforming to the requirements of Occupational Safety and Health Agency (OSHA) standards.

Any equipment with externally powered wiring shall be marked with a laminated plastic nameplate having 3/16-inch high white letters on a red background as follows:

DANGER - EXTERNAL VOLTAGE SOURCE

Safety color coding for identification of warning signs shall conform to ANSI Z535.1.

2.3 ANCHOR BOLTS

Anchor bolts shall be provided for equipment placed on concrete equipment pads or slabs.

2.4 SEISMIC ANCHORAGE

Electrical equipment, except communications, emergency, and standby equipment, shall be anchored to withstand a lateral force of 0.3 times the weight of the equipment.

Communications, emergency, and standby equipment shall be anchored to withstand a lateral force of 0.6 times the weight of the equipment.

The following standard anchoring should be adequate for equipment not classified as communications, emergency, or standby:

Dry transformers - floor-mounted with four anchor bolts

		BOLT DIAMETER
Under 150 kVA	-	3/8
150 to 500 kVA	-	1/2
Over 500 kVA	-	5/8

Panels - floor-mounted with four 1/2-inch diameter anchor bolts

2.5 PAINTING

Enclosures of the following listed items shall be cleaned, primed, and factory-painted inside and outside in accordance with MS MIL-T-704 and the equipment sections of this specification.

ITEM	FINISH COLOR
Circuit Breakers	ANSI No. 61 gray
Substations	ANSI No. 61 gray
Switchgear	ANSI No. 61 gray
Control Components	Manufacturer's standard

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be accomplished by workers skilled in this type of work. Installation shall be made so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors. Except as otherwise indicated, emergency switches and alarms shall be installed in conspicuous locations.

3.2 PAINTING APPLICATION

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks, if not factory painted, shall be thoroughly cleaned and painted as specified in the equipment sections in this specification unless otherwise noted. Work shall be left in a neat and clean condition at final completion of the contract.

Emergency equipment, such as fire-alarm boxes, shall be cleaned, primed, and painted red.

3.3 IDENTIFICATION PLATE INSTALLATION

Identification plates shall be fastened by means of corrosion-resistant steel or nonferrous metal screws. Hand lettering, marking, or embossed self-adhesive tapes are not acceptable.

3.4 EQUIPMENT PADS

Equipment pads shall be constructed with a minimum 4-inch margin around the equipment and supports.

3.5 CUTTING AND PATCHING

Contractor shall install his work in such a manner and at such time as will require a minimum of cutting and patching on the building structure.

Holes in or through existing masonry walls and floors in exposed locations shall be drilled and smoothed by sanding. Use of a jackhammer will be permitted only where specifically approved.

3.6 DAMAGE TO WORK

Required repairs and replacement of damaged work shall be done as directed by and subject to the approval of the Contracting Officer, and at no additional cost to the Government.

3.7 CLEANING

Exposed surfaces of wireways, conduit systems, and equipment that have become covered with dirt, plaster, or other material during handling and construction shall be thoroughly cleaned before such surfaces are prepared for final finish or painting or are enclosed within the building structure.

Before final acceptance, electrical equipment, including lighting fixtures and glass, shall be clean and free from dirt, grease, and fingermarks.

3.8 FIELD TESTING AND TEST EQUIPMENT

All Field testing specified in Divisions 16 electrical specification shall be made with test equipment specially designed and calibrated for the purpose. Test equipment used shall be calibrated and certified by an approved testing laboratory. Date of last calibration and certification shall not be more than 90 calendar days old at the time of field testing.

-- 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

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)

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 1	(1999; R 2005; R 2010) Standard for General Color Requirements for Wiring Devices

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 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 information only. 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:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixture Lists for the following:

Conduits, Raceway sand Fittings

Wire and Cable

Splices and Connectors

2.4 kV Switchgear

Medium voltage cable

34.5 kV Breakers

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Conduits, Raceway sand Fittings

Wire and Cable

Splices and Connectors

2.4 kV Switchgear

Medium voltage cable

34.5 kV Breakers

Spare Parts

Certification

Submittal for vertical assemblies will be reviewed by a licensed Mechanical, Civil or Structural Engineer to determine that the entire assembly will withstand 135 mph wind loading.

SD-06 Test Reports

Continuity Test

Phase-Rotation Tests

Insulation Resistance Test

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions.

1.4 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, refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS. 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 Surface Raceways and Assemblies

Surface metal raceways and multi-outlet assemblies shall conform to NFPA 70. Receptacles shall conform to NEMA WD 1, Type 5-20R.

2.1.8 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 solid.

Flexible cable shall be Type SO and contain a grounding conductor with green insulation.

Conductors installed in plenums shall be marked plenum rated.

2.3 SPLICES AND CONNECTORS

Make all splices in AWG No. 8 and smaller with approved indentor crimp-type connectors and compression tools.

Make all splices in AWG No. 6 and larger with indentor crimp-type connectors and compression tools. Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

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 30 feet long.

3.1.7 Surface Raceways and Assemblies

Surface raceways shall be mounted plumb and level, with the base and cover secured. Minimum circuit run shall be three-wire with one wire designated as ground.

3.1.8 Cable Trays

Support cable trays from ceiling hangers, equipment bays, or floor or wall supports. Cable trays may be mounted on equipment racks. Provide support when the free end extends beyond 3 feet. Maximum support spacing shall be 6 feet. Trays 10-inches wide or less shall be supported by one hanger. Trays greater than 10-inches wide shall be supported by hangers. Bond cable trays at splices.

3.2 WIRING

Feeder and branch circuit conductors shall be color coded as follows:

CONDUCTOR	COLOR AC
Phase A	Yellow
Phase B	Brown
Phase C	Orange
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 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.

3.4 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.

3.5 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted as specified in Section 09 90 00 PAINTS AND COATINGS or Section 09 96 00 HIGH-PERFORMANCE COATINGS.

3.6 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 00.00 98

BASIC ELECTRICAL MATERIALS AND METHODS
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.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA RN 1	(1998) Standard for Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 13	(2005) Standard for Electrical Nonmetallic Tubing (ENT)
NEMA VE 1	(2003) Standard for Metallic Cable Tray Systems
NEMA WD 1	(1999) Standard for General Requirements for Wiring Devices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1	(2004; Rev 2) Standard for Flexible Metal Conduit
UL 1242	(2003; R 2005) Standard for Electrical Intermediate Metal Conduit - Steel
UL 6	(2004e13) Standard for Electrical Rigid Metal Conduit-Steel
UL 797	(2000e8) Standard for Electrical Metallic Tubing
UL 870	(2003e7) Standard for Wireways, Auxiliary Gutters, and Associated Fittings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00.98 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists shall be submitted for the following:

Conduits, Raceway sand Fittings
Wire and Cable
Splices and Connectors
Switches
Receptacles
Outlets, Outlet Boxes, and Pull Boxes
Circuit Breakers
Panelboards
Lamps and Lighting Fixtures
Dry-Type Distribution Transformers

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Conduits, Raceway sand Fittings
Wire and Cable
Splices and Connectors
Switches
Receptacles
Outlets, Outlet Boxes, and Pull Boxes
Circuit Breakers
Panelboards
Lamps and Lighting Fixtures
Dry-Type Distribution Transformers
Spare Parts

SD-06 Test Reports

Continuity and Insulation Resistance Test
Phase-Rotation Tests
Insulation Resistance Test

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted.

1.3 PREVENTION OF CORROSION

Metallic materials shall be protected against corrosion. Equipment enclosures shall have the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09 96 00.00 40 HIGH-PERFORMANCE COATINGS. Aluminum shall not be used in contact with earth or concrete and, where connected to dissimilar metal, shall be protected by approved fittings and treatment. Ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous spare parts not of corrosion-resistant steel shall be hot-dip galvanized except where other equivalent protective treatment is specifically approved in writing.

1.4 GENERAL REQUIREMENTS

Material, Equipment, and Fixture Lists shall be submitted for the

following items showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Manufacturer's Instructions shall be submitted 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 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 be in accordance with UL 6 and shall be galvanized by the hot-dip process. Where underground and in corrosive areas, rigid steel conduit shall be polyvinylchloride (PVC) coated in accordance with NEMA RN 1 or shall 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 shall be accessible after the work has been completed.

2.1.2 Electrical Metallic Tubing (EMT)

EMT shall be in accordance with UL 797 and shall be zinc coated steel. Couplings and connectors shall be zinc-coated, raintight, gland compression with insulation throat. Crimp, spring, or setscrew type fittings shall not be acceptable.

2.1.3 Flexible Metallic Conduit

Flexible metallic conduit shall be in accordance with UL 1 and shall be galvanized steel.

Fittings for flexible metallic conduit shall be specifically designed for such conduit.

Liquidtight flexible metallic conduit shall be provided with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Fittings for liquidtight flexible metallic conduit shall be specifically designed for such conduit.

2.1.4 Intermediate Metal Conduit

Intermediate metal conduit shall be in accordance with UL 1242 and shall be galvanized.

2.1.5 Rigid Nonmetallic Conduit

Rigid nonmetallic conduit shall be in accordance with NEMA TC 13 and shall be PVC with wall thickness not less than Schedule 40.

2.1.6 Wireways and Auxiliary Gutters

Wireway and auxiliary gutters shall be a minimum 4- by 4 inch trade size conforming to UL 870.

2.1.7 Surface Raceways and Assemblies

Surface metal raceways and multi-outlet assemblies shall conform to NFPA 70. Receptacles shall conform to NEMA WD 1, Type 5-20R.

2.1.8 Cable Trays

Cable trays shall be ladder type conforming to NEMA VE 1.

2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 600-volt type XHHW. All conductors AWG No. 8 and larger, shall be stranded. All conductors smaller than AWG No. 8 shall be solid.

Flexible cable shall be Type SO and shall contain a grounding conductor with green insulation.

Conductors installed in plenums shall be marked plenum rated.

2.3 SPLICES AND CONNECTORS

Splices in AWG No. 8 and smaller shall be made with approved indentor crimp-type connectors and compression tools.

Splices in AWG No. 6 and larger shall be made with indentor crimp-type connectors and compression tools. Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

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 contain not more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Crushed or deformed conduit shall not be installed. Trapped conduit runs shall be avoided where possible. Care shall be taken to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clogged conduit shall be cleared of obstructions or shall 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

Field-made bends and offsets shall be made with approved hickey or conduit bending machine. Conduit elbows larger than 2-1/2 inches shall be long radius.

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, shall be provided with a flush coupling when the floor slab is of sufficient thickness. Otherwise, a floor box shall be provided and 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

Flexible metallic conduit shall be used 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

Field-made bends and offsets shall be made with approved hickey or conduit bending machine. Intermediate metal conduit shall be used 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 shall 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. Unused conduit openings shall be plugged.

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 shall be not more than 30 feet long.

3.1.7 Surface Raceways and Assemblies

Surface raceways shall be mounted plumb and level, with the base and cover secured. Minimum circuit run shall be three-wire with one wire designated as ground.

3.1.8 Cable Trays

Cable trays shall be supported from ceiling hangers, equipment bays, or floor or wall supports. Cable trays may be mounted on equipment racks. Support shall be provided when the free end extends beyond 3 feet. Maximum support spacing shall be 6 feet. Trays 10-inches wide or less shall be supported by one hanger. Trays greater than 10-inches wide shall be supported by two hangers. Cable trays shall be bonded at splices.

3.2 WIRING

Feeder and branch circuit conductors shall be color coded as follows:

CONDUCTOR	COLOR AC
Phase A	Yellow
Phase B	Brown
Phase C	Orange
Neutral	White
Equipment Grounds	Green

Conductors up to and including AWG No. 2shall 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.

Splices shall be in accordance with the NFPA 70. Conductor identification shall be provided 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 BOXES AND FITTINGS

Pullboxes shall be furnished and installed 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.

Boxes and enclosures shall be securely mounted to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

3.4 IDENTIFICATION PLATES AND WARNINGS

Identification plates shall be furnished 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.

Identification plates shall be furnished 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.

3.5 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted as specified in Section 09 90 00.00 40 ARCHITECTURAL PAINTING or Section 09 96 00.00 40 HIGH-PERFORMANCE COATINGS.

3.6 FIELD TESTING

After the installation is complete wire and cable shall be given a continuity and insulation resistance test. Insulation resistance test shall be with a 1000 - volt insulation test set. Readings shall be recorded after a minimum of 3 minutes and until the reading is constant for 1 minute. Resistance between phase conductors and ground shall be no less than 25 megohms.

Phase-rotation tests shall be conducted on three-phase circuits using a phase-rotation indicating instrument. Phase rotation of electrical connections to connected equipment shall be A, B, C left to right, or top to bottom facing the equipment.

Transformers shall be given an insulation resistance test. Resistance between each phase and ground shall be not less than 25 megohms.

Final acceptance will depend upon the satisfactory performance of the equipment under test. No conductor or circuit shall be energized until the installation has been approved by the Contracting Officer. Final test data shall be provided to the Contracting Officer. Data shall have a cover letter/sheet 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."

-- End of Section --

SECTION 26 05 13.00 98

MEDIUM-VOLTAGE CABLES
09/12

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced.

ASTM INTERNATIONAL (ASTM)

ASTM B 3	(2001; R 2007) Standard Specification for Soft or Annealed Copper Wire
ASTM B 8	(2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 525	(2007) Design and Installation of Cable Systems in Substations
IEEE Std 525-2007	(2007) IEEE Guide for the Design and Installation of Cable Systems in Substations

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA CC 1	(2005) Electric Power Connectors for Substations

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2008) National Electrical Code

1.2 DEFINITIONS

Medium voltage power cables shall mean all cables rated above 601 to 46,000 volts.

1.3 GENERAL REQUIREMENTS

Section 26 05 00.00 98 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00.98 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-01 Product Data

Equipment and Performance Data shall be provided for the following items:

Cables
Termination Kits
Splicing Kits

SD-03 Product Data

Manufacturer's Catalog Data shall be provided for the following items:

Cables
Termination Kits
Splicing Kits

SD-04 Samples

Compression samples shall be provided in accordance with paragraph entitled, "Splices and Terminations".

SD-06 Field Test Reports

Provide field test reports for the following in accordance with the paragraph entitled, "Field Testing," of this section.

Pre and Post, High Potential, Insulation Resistance Tests (Megger tests)
High-Potential Tests
Phasing Tests

SD-07 Certificates

Certificated of Compliance shall be provided for the following showing that the cable manufacturer has made factory-conducted tests on each shipping length of cable. Certified copies of test data shall show conformance with the referenced standards and shall be approved prior to delivery of cable. Also qualifications of Cable Splicers shall be provided to the Contracting Officer prior to specified work.

Conductor Resistance
Ionization
High-Voltage Test
Flammability
Mechanical Integrity
Bending Test
Minimum Bending Radius
Dielectric Power Loss
Power Factor Test
Qualifications of Cable Splicers

SD-08 Manufacturer's Instructions

Provide manufacturer's instructions showing the recommended sequence and method of installation for the following:

Medium and High Voltage Power Cables
Termination Kits

Splicing Kits

1.5 QUALIFICATIONS

Personnel performing splicing and/or terminations are required to have 5 years experience in preparing cable splices and terminations. Once a termination or splice has been started by a worker, the same person shall complete that particular splice and/or termination. Each termination and splice shall be started and completed in one continuous work period.

1.6 CABLE VOLTAGE RATINGS

Medium-voltage power cables shall include multiple- and single-conductor cables for use with three-phase, 60 hertz grounded and ungrounded neutral distribution systems and shall be rated line-to-line, as follows:

SYSTEM VOLTAGE	NOMINAL CABLE RATING
2.4 kV	5 kV Shielded
34.5 kV	35 kV Shielded w/133 percent insulation or 46 kV Shielded w/100 percent insulation

1.7 SHIPMENT OF CABLE

Cable shall be shipped on reels such that the cable will be protected from mechanical injury. Each end of each length of cable shall be hermetically sealed and securely attached to the reel.

Minimum reel drum diameter 14 times the overall diameter of the cable. A pulling eye shall be installed by the manufacturer for each length of cable supplied.

A copy of the factory test shall be provided to the Contracting Officer for review prior to shipping cable. If the Contractor is satisfied that the manufacturer's test results meet contract specifications then the Contractor may authorize shipment of cable. This is the Contractor's acceptance of the cable as manufactured and is not the final government acceptance of the cable. The government shall only accept the cable in its final installed and tested condition.

1.8 RECEIVING CABLE

The Contractor, upon receipt of cable shipments at the GRC Lewis Field site, should visually inspect all reels for both hidden and obvious damage prior to accepting delivery. Any damage found should be noted on the receiving documents and the carrier advised. If any damage is found, the Contracting Officer is to be notified of what action the Contractor will take.

For handling and storage of cable see paragraph 3.1.4.

PART 2 PRODUCTS

2.1 5 kV and 35 kV SOLID DIELECTRIC CABLE

2.1.1 Type and Application

All power cables will be shielded type with copper conductors and are intended for installation in cable trays or underground ducts. 5 kV cables shall be single-conductor or three-conductor type as indicated on

the drawings. 35 kV cables shall be single conductor triplexed type. Cable construction shall conform to NEMA WC 74.

The applied system voltage (line-to-line) will be 2,400 volts ungrounded delta for the 5 kV cable type and will be 34,500 volts grounded wye for the 35 kV cable type.

2.1.2 Conductors

Conductors shall be class B stranded, uncoated copper in conformance with ASTM B 3 and ASTM B 8 and ICEA S-93-639 with the minimum number of wires noted below:

Conductor Size Range	Number of Strands
8 - 2	7
1 - 4/0	19
250 - 500	37
501 - 1000	61

Conductors shall be free from moisture, corrosion and excessive drawing lubricant before conductor shielding is applied. Conductor sizes shall be as indicated on the drawings.

2.1.3 Conductor Shield, Insulation, and Insulation Shield

The conductor shield, insulation, and insulation shield shall be triple tandem extruded, ethylene-propylene rubber and shall be rated for a conductor temperature of 90 degrees C, wet or dry.

Cables shall have an average insulation thickness of:

Voltage Rating	Conductor Size	Insulation Thickness in mils
5 kV	1 - 4 AWG	110
	250 - 500 kcmil	140
	750 - 1000 kcmil	155
35 or 46 kV	500 kcmil or less	445
	750 kcmil or more	345

The minimum insulation thickness due to eccentricity, for all cables, shall not be less that 90 percent of the average insulation thickness listed.

2.1.4 Metal Tape Shield

A flat, 5 mil thick,, copper tape shall be applied helically around the insulation shield with a minimum overlap of 12.5 percent. The tape shall be free from burrs and, where jointed, shall be made electrically continuous. Application of the tape shield shall not deform the insulation.

2.1.5 Ground Wire

A bare, copper wire, class B stranded, in conformance with ASTM B 8 shall be provided in three-conductor cable assemblies. The size of the ground shall be as follows:

Energized Conductor Size	Ground Wire Size
1 - 2/0 AWG	4 AWG

4/0 - 250 kcmil	3 AWG
350 kcmil	2 AWG
500 kcmil	1 AWG
750 - 1,000 kcmil	1/0 AWG

2.1.6 Jacket

A black polyvinyl chloride compound (PVC) low smoke type, jacket meeting the requirements of ICEA S-93-639, shall be provided over all single-conductor and tree-conductor cable assemblies. The average thickness of the PVC jacket in mils shall not be less than the following:

Conductor Size	Single Conductor Cable	Three Conductor Cable	
		No Armor	Armor
1 AWG	80	80	60
1/0 AWG	80	80	60
2/0 AWG	80	80	60
3/0 AWG	95	110	60
250 kcmil	110	110	60
350 kcmil	110	110	75
500 kcmil	110	110	75
750 kcmil	125	140	85
1,000 kcmil	125	140	85

2.1.7 Identification

A continuous identification strip shall be printed along the outer jacket of the cable which identifies the cable manufacturer, voltage rating, cable type, conductor size, and year of manufacture. Individual phases shall be color coded with a black, red, or blue strip under the metallic shield of each conductor.

2.1.8 Cable Dimensions

Cable dimensions shall be in accordance with ICEA S-97-682.

Diameters over insulation shall be in accordance with ICEA S-97-682.

2.2 SOLID DIELECTRIC CABLE ACCESSORIES

Cable termination lugs shall be the seamless, copper, one piece terminals with a two-hole lug conforming to NEMA CC 1 and shall be suitable for medium voltage applications. The barrel of the terminal lug shall be cable of accepting a minimum of two compressions. Bolting hardware shall be 15 mm stainless steel with one hex head bolt, two flat washers, one Belleville washer, and one hex head nut.

Termination kits for cables terminated in switchgear compartments or air-filled transformer compartments shall be the heat shrink, cold shrink, or pre-molded type as manufactured by 3M, Raychem, or Elastimold or equal. Skirts shall be provided with all stress cone termination kits for improved tracking characteristics. Busbar connections in switchgear and transformer termination compartments shall be sealed with a bus bar connection kit such as Raychem Type HVBC or equal.

Termination kits for cables terminated outdoors shall be the porcelain type as manufactured by G&W or equal.

Termination kits for terminating cables in oil-filled transformer compartments shall be as manufactured by G&W or equal.

Cable splices for joining solid dielectric cables shall be as manufactured by 3M, Raychem, or Elastimold or equal.

The splicing of solid dielectric to Paper Insulated Lead Covered (PILC) gas filled cable is not acceptable.

2.3 CABLE SUPPORTS AND FITTINGS

Cable supports, related fittings, and accessories shall be provided for use in corrosive underground locations, such as manholes and utility tunnels, with a factory applied coating of polyvinylchloride of at least 20 mils thick. Provide polyvinylchloride (PVC) coated items that have a uniform thickness and be free of blisters, breaks, and holidays. Provide PVC compound that conforms to ASTM D 746.

Provide cable racks, cable tray supports and related fittings that are UL listed heavy duty nonmetallic glass reinforced nylon or equal.

2.4 END CAPS

End caps intended for sealing exposed cable ends shall be Raychem heat shrinkable type or the 3M prestretched type or equal.

2.5 CABLE IDENTIFICATION TAGS

Cable identification tags shall be non-magnetic, metallic band type, embossed with circuit number and installation date. Lettering shall be a minimum of high. See NASA GRC High Voltage Electrical Power Operating Instruction, GRC HVEPS-OI-07 and GRC HVEPS-OI-03 for placing of temporary identification tags.

2.6 CABLE TIES

Cable ties used to tie cables tray shall be the Panduit nylon type or equal.

2.7 CABLE PULLING LUBRICANT

Cable pulling lubricant shall be Polywater "J" or equivalent type approved by the cable manufacturer.

2.8 2400V BRANCH CIRCUIT CREATION (SECTIONALIZERS)

At GRC and Lewis field any new 2400V branch circuits shall be created using Elastimold or equal "H-Joint" type non-load break cable connectors and shall be referred to as sectionalizers.

Each sectionalizer shall be 4-way and have all parts necessary to create a working system as recommended by the manufacturer. Each sectionalizer shall have a main feeder and three ports available for branch circuits. Each sectionalizer and all associated cables and equipment are to be named and labeled according to the naming conventions of HVEPS-OI-6. Any unused sectionalizer ports shall include a removable end cap from the manufacturer that prevents any exposure of live high voltage connections on any unused sectionalizer ports after installation is complete.

Sectionalizer shall have the following ratings at a minimum:

Operating Voltage	L-L15kV, L-G 8.3kV
BIL (Basic Impulse Level)	95kV
Withstand Voltage	AC One Minute 34kV
Corona Extinction Level	11kV
Continuous Current	600A @ 90 degrees C
Momentary Current	25kA for 10 cycles

PART 3 EXECUTION

3.1 INSTALLATION

Medium-voltage cables shall be installed in accordance with NFPA 70 and IEEE Std 525-2007.

Cable shall be installed in underground duct banks; in conduit above and below grad; inside building; on racks; and cable trays in utility tunnels and manholes.

Cables shall be secured with heavy duty cable ties in existing or new trays mounted horizontally, where cable rests on tray bottom. Cable ties shall be installed at minimum of 10 foot intervals.

Cables shall be secured with non-metallic cable clamps, straps, hangers, or other approved supporting devices to tunnel walls, ceilings, and in new or existing cable trays mounted vertically, where tray bottom is in a vertical plane.

Contractor shall ensure that all cable tray properly secured and supported prior to installing new cable. Contractor shall add new permanent and/or temporary tray support devices as required to preclude cable tray failure during cable pulling or after cable is installed

Cable or conductors of a primary distributions system shall be rejected when installed openly in cable trays or openly racked along interior walls; in the same raceway or conduit with ac/dc control circuits or ac power circuits operating at less than 600 volts; or in a manner allowing cable to support its own weight.

3.1.1 Suitability of Conditions of Installation Before Pulling Cable

Contractor shall ensure that radii of bends, potheads, fittings, cable risers, and other conditions are suitable for the cable and conform to the recommendations of the cable manufacturer.

Contractor shall not install cable when temperatures are less than the cold bend temperature rating of the cable products plus 15 degrees C (i.e., minimum installation temperature = cold bend temperature rating + 15 degrees C). For example: when installing a cable with a cold bend temperature rating of -25 degrees C, the minimum recommended installation temperature is -10 degrees C.

(Note: The cold bend temperature ratings are indicated on the catalog

Spec sheets.)

Prior to performing a low temperature (less than 10 degrees F or -12 degrees C) cable installation, cable should be stored for a minimum of 24 hours at a temperature of 55 degrees F (13 degrees C) or higher. Cable should be pulled more slowly and trained in place the same day it is removed from storage.

Do not impact, drop, kink or bend cable sharply in low temperatures. Concentric neutral power cable are suitable for storage and operation at -40 degrees F (-40 degrees C). Cold weather handling should not be done when the temperature of the cable is below -13 degrees C (-25 degrees C).

For installations at lower temperatures, the cable should be warmed for a minimum of 48 hours at room temperature (above 59 degrees F or 15 degrees C) prior to handling.

3.1.2 Protection During Splicing Operations

Contractor shall provide blowers to force fresh air into manholes or confined areas where free movement or circulation of air is obstructed. Waterproof protective coverings shall be available on the work site to provide protection against moisture while splice is being made. Pumps shall be used to keep manholes dry during splicing operations. Under no conditions shall a splice or termination be made with interior of a cable exposed to moisture. A manhole ring at least 6 inches above ground shall be used around the manhole entrance to keep surface water from entering the manhole. Unused ducts shall be plugged and water seepage through ducts in use shall be stopped before the splice is started.

3.1.3 Duct Cleaning

Contractor shall thoroughly clean ducts before installation of power cables. Pull a standard flexible mandrel through each duct to loosen particles of earth, sand, or foreign material in the line. Provide not less than 12-inch long mandrel with a diameter 1/2 inch less than the inside diameter of the duct. Then pull a brush with stiff bristles through each duct to remove the loosened particles. Provide brush diameter that is the same as or slightly larger than the diameter of the duct.

3.1.4 Cable Handling and Storage

If cable reels are lifted by crane, a shaft through the arbor hole shall be used with an appropriate spreader to avoid damage to the reel flanges. If a forklift is utilized, the forks shall make complete lifting contact with the shaft protruding through the arbor hole of the cable reel. Under no circumstances shall the forks of the forklift contact the cable surface or protective wraps.

The contractor shall take all necessary precautions to avoid dropping a cable reel. Reels shall be stored on wood planking so that the flanges do no sink into the earth and allow the weight of the reel and cable to rest on the cable surface.

Reels shall be stored in an area where construction equipment, falling objects or other materials will not contact the cable.

When a reel of cable is rolled from one point to another, care must be

taken to be sure there are no objects on the surface area which could contact or damage the cable surface.

Installation of cable is strictly prohibited when the ambient temperature is below -5 degrees C. When the temperature prior to cable installation has been below -5 degrees C, the cable may be installed provided the cable has been kept in a heated storage at a minimum temperature of -5 degrees C for minimum of 8 hours immediately prior to installation. Provisions for heated storage shall be the responsibility of the Contractor.

Cable reels shall be stored with the flanges in the vertical position at all times.

3.1.5 Pulling Eyes and Cable Grips

Large size, heavy cables, or cable for pulls that are particularly long or contain numerous bends or changes in curvature, are best installed by means of a pulling eye attached to the conductor/s. The pulling eye is fastened directly to the conductor/s on the end of the cable by soldering the copper conductors into a socket-type eye or mechanically compressing the aluminum conductors into an aluminum eye. A solder wipe, heat shrinkable tube or tape seal is applied over the eye-cable joint to provide a reliable weather-tight seal for the cable during cable pulling. On armored cables, the armor should be properly secured to the eye to insure cable integrity during pulling. Pulling eyes are usually installed at the factory but, if required, can be assembled in the field.

Woven wire pulling grips or "baskets" - such as the Kellerns grips - are often used to pull such cables, and are particularly suited for pulling smaller size/lower voltage cables, or where the pulls are relatively short and straightforward. When such devices are to be used on CCW sheathed or interlock Armored cables, special procedures must be followed to avoid damage to the cable or problems in making the pull. Since the CCW Sheath or Interlock Armor may not be a tight, gripping fit on the cable core, the pulling grip may tend to strength or elongate the sheath or armor in relation to the core, if the grip is not properly applied to the cable. The following method of preparing the cable and attached the grip is therefore recommended:

1. Select the grip size which best fits the cable "core" (diameter under sheath or armor". Determine the length of the gripping portion of the grip.

2. Locate two points on the end of the cable. The first is 75 percent of the grip length from the end, the second is 100 percent of the grip length from the end.

3. Remove the sheath or armor (and outer jacket - if present) to the first mark. Do not damage or disturb the core. If necessary, secure the armor at the cut point with friction tape before cutting.

4. Apply four, 3 inch long, tight, half-lapped wrappings of friction tape a) on end of core, b) on core to edge of sheath or armor, c) on jacket, sheath or armor to edge of same, and d) on jacket, sheath, or armor where last 3 inches of grip will be located.

5. If cable is likely to be exposed to moisture during the pull, seal the cut ends of the conductors with sealing mastic and vinyl tape, or heat-shrinkable cap/s.

6. Place the grip on the cable and snug it down tight by "milking" it from the cable end towards the end of the grip.

7. Secure the grip to the cable by clamping the back end of the grip to the cable with a steel, strap-type hose clamp (such as the "Punch-Lok" or "Band-It" types) or a robust steel wire serving, tightly applied.

8. Apply a tape wrapping over the clamp or serving to smooth it off to prevent "hang up" drag the pull.

Caution - The ends of cables pulled in this manner will not be completely sealed against the entry of water. If this is of concern, then properly applied pulling eyes should be used.

*Note - Since the compressive force applied by a pulling grip may disturb/damage the underlying cable, it is best to cut off this section of the cable before splicing or terminating.

3.1.6 Cable Guides

Precautions during cable pulling
Cable Guides - To avoid abrasion and damage of the cable jacket when guiding the cable from the reel to the duct mouth or trench, all guides should be in the form of large diameter, smooth-surfaced, free-turning sheaves or rollers. If guide tubes or chutes must be used, they should have smooth, burr-free working surfaces, well flared entrances, largest possible bend radii, and be securely anchored so that cable passes smoothly over them. Cable tension going into the guides should be kept very low by mounting the cable reel in sturdy jacks, carefully leveling the reel shaft, and lubricating the reel arbor holes and shaft with grease. Braking of the reel should be done only to prevent reel over run when the pull is slowed or stopped or on steep down-hill runs where cable weight is enough to overcome cable-duct friction.

Much of this information is equally true for rack or tray installations. In addition, the following points should be carefully observed when making such pulls: 1) cable support rollers should be spaced close enough so that the cable's normal sag, even when under tension, will not result in its dragging on the tray; 2) The cable rollers or sheaves should be flanged or contoured so that the cable will not ride off the end of the roller, or be "pinched" into a sheave contour diameter that is smaller than that of the cable; 3) Where rollers/sheaves are used to guide the cable through bends, it is essential that a sufficient number of them be used so as to support and guide the cable in a smooth curve of the desired radius from tangent point to tangent point. Otherwise, the cable will be "kinked" around the radius of each roller.

3.1.7 Pulling EPR Insulated Cables in Ducts, Manholes and Utility Tunnels

Medium-voltage EPR insulated cables shall be pulled into ducts and utility tunnels with equipment designed for this purpose, including power-driven winch, cable-feeding flexible tube guide, cable grips, and lubricants. A sufficient number of trained personnel and equipment shall be employed to ensure the careful and proper installation of the cable.

Cable reel shall be set up at the side of the manhole or tunnel hatch opening and above the duct or hatch level, allowing the cable to enter through the opening without reverse bending. Install flexible tube guide through the opening in a manner that prevents the cable from rubbing on the edges of any structural member.

One week prior to pulling any cable of a length of 200 feet or longer, the contractor shall provide to the Contracting Officer calculations for the expected pulling tension and sidewall pressure on that cable for the actual configuration as to be installed. The calculations shall show the expected pulling tensions in either direction and demonstrate that the anticipated pulling tensions are less than the maximum pulling tensions allowable.

The contractor should pull the cable in the direction which minimizes tension on the cable. If the direction of the pull is in other than the direction of the lesser tension/pressure the contractor is to provide rationale for approval by the Contracting Officer.

The working load specified by the manufacturer of the pulling devices (pulling eyes, ropes, anchors, basket grips, etc.) shall not be exceeded.

The force (or what results in and is more commonly referred to as pulling tension), using a pulling eye, required to pull cable with copper conductors into a duct, conduit, or cable tray shall not exceed the lesser value of that as provided by the manufacturer, or 10,000 pounds, or as computed (based on IEEE Std 525 - 2007) from the following equation:

T max = 0.008 x N x CM

Where:

T max = maximum allowable pulling tension in pounds

0.0008 = a constant factor, in pounds per circular mil, applicable for copper conductors

For less than 3 single conductors of equal size being pulled simultaneously;
N = 1 for a single conductor
N = 2 for two single conductors

For 3 single conductors of equal size being pulled simultaneously;
N = 2 (experience has shown that two, rather than three, of the conductors may be subjected to the full pulling tension)

For greater than 3 single conductors of equal size being pulled simultaneously;
N = (number of conductors to be pulled) x(.6)
A factor of .6 is applied to reduce the max pulling tension by 40 percent in order to account for uneven distribution of pulling tension among all conductors

For a three-conductor cable or triplexed cable;
N = 3

(**Note:** For pulling multiple single conductors of unequal sizes consult the manufacturer.)

CM = cross-sectional area of each conductor in square circular mils

The maximum allowable pulling tension when using a basket grip shall be the lesser of 1,000 lbs per grip or the the value calculated (in preceding equation) when using a pulling eye. The limit applies to a single conductor cable; a multi-conductor cable with common overall jacket; two or more twisted cables; or paralleled cables with one basket grip applied to the single cable or group.

When used, pulling eyes shall be connected to the cable conductors in order to prevent damage to the cable structure.

Pulling tensions shall be monitored by a dynamometer whenever circuit lengths exceed 200 feet.

Cable shall be unreeled from the top of the reel. Payout shall be carefully controlled. Where cable to be pulled is greater than 200 feet long and greater than 2 inch diameter, the cable shall be attached through a swivel to the main pulling wire by means of a pulling eye. Where cable are less that 200-feet long and are less than 2 inches in diameter another suitable cable grip means may be permitted for pulling the cable. Where cable to be pulled is greater than 200 feet long and greater than 2 inch diameter, pulling eyes and cable grips shall be used together for pulling nonmetallic sheathed cables to prevent damage to the cable structure.

Minimum bending radius shall be in accordance with the following:

CABLE TYPE	MINIMUM BENDING RADIUS MULTIPLIES TIMES CABLE DIAMETER
RUBBER AND PLASTIC INSULATED CABLE WITH OR WITHOUT INTERLOCKED ARMOR	
Non-shielded cable	8
Shielded cables	12

Note: Training versus bending
Training is the positioning of cable when it is not under tension.
Bending is the positioning of cable when it is under tension.

When installing cable, the object is to limit the mechanical forces so that the cable's physical and electrical characteristics are maintained for the expected service life. Bends in conductors, multi-conductor cables, or assemblies of conductors shall be made so that the cable will not be damaged.

A non-shielded cable can tolerate a sharper bend than a shielded cable. This is especially true for cables having helically applied metallic shielding tapes which, when bent too sharply, can separate or buckle and cut into the insulation.

Remember that offsets are bends. The problem is compounded by the fact that most tapes are under jackets that conceal such damage. The extruded polymers used for insulation shields have sufficient conductivity and coverage initially to pass acceptance testing and then fail prematurely due to corona at the shield/insulation interface.

Minimum Bending Radius (Static Conditions)
The minimum values for the radii to which such cables may be bent for permanent training can be determined by the following formula:

MBR = OD x M

Where: MBR = Minimum radius of bend (in)
OD = Outside diameter of cable (in)
M = Diameter multiplier (See previous table)
The above calculation is for STATIC conditions ONLY. Reference the DYNAMIC Condition section (as follows) as well as the Sidewall Bearing Pressure section for the minimum bending radius of cable in motion.

Minimum Bending Radius Radius (Dynamic Conditions)
The minimum values for the radio to which such cable may be bent while being pulled into an installation and while under tension can be determined by the formula following this paragraph. This value will greatly depend on the tension the cable is experiencing as it exits the bend in question. For instance the greater the exiting tension, the greater the minimum bending radius will be for the cable.

MBR = (Te / SWBP) X12 (inches)
Where: MBR = Minimum radius of bend (in.)
Te = Tension as cable exits the bend (pounds force)
SWBP = Maximum allowable Sidewall Bearing Pressure (pounds force per foot of bend radius)

Cables shall be liberally coated with a suitable cable-pulling lubricant as it enters the tube guide or duct. Nonmetallic sheathed cables shall be covered with wire-pulling compounds when required which have no deleterious effects on the cable. Rollers, sheaves, or tube guides shall be provided around which the cable is pulled that conform to the minimum bending radius of the cable.

Cable shall be pulled into ducts at a speed not to exceed 50 feet per minute and not in excess of maximum permissible pulling tension specified by the cable manufacturer. Cable pulling using a vehicle is not permitted. Pulling operations shall be immediately stopped with any indication of binding or obstruction and shall not be resumed until such difficulty is corrected. Sufficient slack shall be provided for free movement of cable due to expansion or contraction.

Cable splices shall be made up in manholes or utility tunnels shall be firmly supported on cable racks as indicated. No cable splices shall be pulled in ducts. Cable ends shall overlap at the ends of a section to provide sufficient undamaged cable for splicing. Cables to be spliced in manholes or utility tunnels shall overlap the centerline of the proposed joint by not less than 2 feet.

Cables cut in the field shall have the cut ends immediately sealed to prevent entrance of moisture. Seal cable with rubber tape wrapped down to 3 inched from the cable end and then cover-wrap rubber tape with polyvinylchloride tape.

3.1.8 Splices and Terminations

Splices shall be made in manholes or tunnels. Splicing and terminating of cable shall be expedited to minimize exposure and cable deterioration.

Cable terminations and splices shall be field fabricated from kits supplied by and in accordance with the manufacturer's recommendations for the type, size, and electrical characteristics of the cable.

Cable splices in manholes shall be located midway between cable racks on walls of manholes and supported with cable arms at approximately the same elevation as the enclosed duct.

Cable splices in the tunnel which are not installed in cable trays shall be installed on cable racks or by other approved methods which will minimize physical stress on the splice connections. Splices shall be at approximately the same elevation as the installed cable except where space limitation or existing cable length limitations make this method impractical or impossible.

All terminations shall be made by a certified cable splicer in strict accordance with termination/splice manufacturer's instruction.

Cables to be terminated shall be trained and racked into their final positions before any cable is cut.

All joints shall be made only with approved tools and materials in the prescribe manner to produce a tight and secure joint. When preparing conductor ends, care shall be taken in removing insulation so that conductors are not deformed or nicked. No termination shall be made when conductor strands are missing or deformed in any way.

When a cable is opened for termination or splicing, work shall continue uninterrupted until the termination or splice is completed, including any sealing.

The proper compression die and hydraulic pressure shall be used for all compression as recommended by the splice and termination lug manufacturer. One sample compression of each size and type terminal lug and splicing barrel shall be submitted for approval prior to beginning terminating or splicing activities. The contractor shall cut terminal lug or splicing barrel 90 degrees to the axis of the connector to provide a cross-sectional view of the compressed conductor strands.

After compression, the conductor and it's associated connector shall have all burs removed, leaving smooth and round surfaces.

3.1.9 Temporary Name Tags for Power Cables and Apparatus

The Contractor shall only use Government furnished temporary name tags. Contractor shall attach temporary name tags to power apparatus and cables installed by the Contractor. The Contractor shall also attach temporary name tags to power apparatus and cable renamed as part of the contract. The Contractor shall place temporary name tags to be visible and correctly read from left-to-right or from top-to-bottom by a person facing the front of the power apparatus or cable.

The Contractor shall place temporary name tags using plastic self-locking cable ties similar to TY-RAP Cable Ties, Catalog Number TY528M, 50 pound minimum holding strength, Thomas and Betts Company, Edison, New Jersey or equal.

3.1.10 Temporary Tags Placed on High Voltage Apparatus

The Contractor shall place a temporary name tag on power apparatus in one of the following locations:

a. A hasp for padlocking the apparatus providing the tag or cable tie does not impede the opening or closing or a compartment;

b. A hole in the supporting steel work of the apparatus;

c. A suitable appendage from the apparatus from which the tag may not be removed without cutting the cable tie;

d. The operating pipe for a disconnect switch; or

e. In the event that none of the above locations are suitable for the tag, the tag shall be placed at the direction or the Government.

The Contractor shall attach a temporary name tag to power apparatus using a plastic cable tie passing through both holes at the top/left end of the plastic tag. Each cable tie shall pass once through a suitable hole or once around a suitable appendage on power apparatus and the two ends shall be joined together. A Contractor may remove his temporary name tags prior to inspections and acceptance by the Government. Following inspection and acceptance of the name tag by the Government, the inspector shall insert a second plastic cable tie through the two remaining holes at the right/bottom end of the name tag and shall join them together to form a hanging loop.

3.1.11 Temporary Name Tags Places on Cables

Contractor shall install temporary name tags to each cables at each of the following locations:

a. cable-entrance to metal-clad switchgear;

b. Cable-entrance and cable-exit to manholes and tunnels;

c. Cable entrance to sectionalizing boxes;

d. Cable splices;

e. Cable terminations;

f. Cable at power transformers; and

g. At 30 meter intervals in tunnels.

The Contractor shall attach a temporary name tag to cables using a cable tie attached through two (2) holes at the left/top end of the plastic tag. The cable tie shall pass once around a cable and the two ends shall be joined together. A Contractor may remove his temporary name tags prior to acceptance by the Government.

Following acceptance of the temporary name tag, the inspector shall attach a second plastic cable tie through the two holes in the right/bottom end of the name tag; this cable tie shall pass once around the cable and the two ends shall be joined together.

The Contractor shall also use non-metallic tags to mark phases of cables supplied under contract at all termination locations. Marking shall be visible by a person facing the cables. Tags identifying electrical phases shall be of the following types:

a. Colored tape wrapped around each conductor, where:
Black Tape for Phase 1;
Red Tape for Phase 2;

Blue Tape for Phase 3.

b. Continuous conductor tracer.

3.1.12 Removal of Tags

The Contractor shall not remove a standard tag; remove a temporary name tag installed by another Contractor; remove a temporary name tag installed by the Contractor which has been inspected and accepted by the Government; remove an old name tag; or place a temporary name tag which obstructs a standard name tag.

3.1.13 Sealing of Cable Ends

Cable ends shall be kept sealed at all times except when preparing pulling eyes, splices, or terminations. In no case shall cable end be left unsealed overnight.

Pulling eyes shall be prepared so that moisture cannot enter the cable conductor.

An end cap shall be applied whenever cable ends are not sealed by a pulling eye, termination, or factory seal.

Water found in the strands of the conductor shall be purged by blowing dry nitrogen through the conductor strands at a nominal pressure of 28 kPa (4 PSI).

If the cable has been purged of water, a cable dryness test shall be performed after it appears that the cable is dry. With nitrogen still flowing through the cable, a desiccant shall be placed at the opposite end of the cable to monitor nitrogen which is exiting the conductor strands. The cable will be considered dry when the color of the desiccant remains unchanged for a period of 30 minutes.

3.1.14 Electrical Work and Electrical Phasing Procedure

This procedure shall begin with electrical equipment which although deenergized will supply electric power to the new or existing facilities. The steps below define the general method that shall be used to safely connect each conductor.

Note: All lengths of cable rated 6600 volts and above shall be Doble Power Factor Tested prior to physical connection. No cable section shall be connected to a feeder breaker or transformer using this procedure.

In the device at the supply end of a new cable section, identify which conductor is to be connected to Phase 1; identify which position (top, front, left) the conductor will occupy. At the other end of the cable identify the position in the device (top, front, left) that phase will occupy. Perform a continuity test (subpart entitled "Electrical Phasing Test"). After confirming continuity of the conductor, permanently tag both ends of the conductor as Phase 1.

In the device at the supply end of a new cable section, identify which conductor is to be connected to Phase 2; identify which position (middle) the conductor will occupy. At the end of the cable identify the position in the device (middle) that phase will occupy. Perform a continuity test (subpart entitles "Electrical Phasing Tests"). After confirming continuity of the conductor, permanently tag both ends of the conductor as Phase 2.

In the device at the supply end of a new cable section, identify which conductor is to be connected to Phase 3; identify which position (bottom, back, right) the conductor will occupy. At the other end of the cable identify the position in the device (bottom, back, right) that phase will occupy. Perform a continuity test (subpart entitled "Electrical Phasing Test"). After confirming continuity of the conductor, permanently tag both ends of the conductor as Phase 3.

At the load end of a new cable section, install new cable links as may be necessary. Permanently tag both ends of the cable with the Government supplied tag showing the NASA cable circuit name/number and date of installation (subpart entitled "Apparatus and Cable Identification").

The above steps shall be used to connect each new cable section.

After the new cable circuit has been electrically tested and connected, the continuity of all phases and neutrals shall be continuity tested for the new circuit between the supply end and the load end (subpart entitled "Electrical Phasing Tests").

3.1.15 Fireproofing

Cables in manholes and tunnels shall be fireproofed with one layer of one half-lapped 3M 77 tape applied and held in place with 3M 69 tape. The fireproofing tape shall completely cover each cable and hand-taped splice from duct entrance to duct exit.

3.2 FIELD TESTING

After the installation of power cables (including splices, joints, and terminations) have been completed and before each cable is energized, each cable shall be subjected to dielectric-absorption and high-voltage testing by an independent testing contractor.

Test equipment, labor and technical personnel as necessary shall be provided to perform the electrical acceptance tests. Test equipment shall have calibration certificates not more than one year old.

Arrangements shall be made to have tests witnessed and approved by the Contracting Officer.

Each power-cable installation shall be completely isolated from extraneous electrical connections at cable terminations and joints. Safety precautions shall be observed.

Each new power cable of a power circuit shall first be given a full dielectric-absorption test (Pre High Potential Test) with a 5000-volt insulation-resistance test set for cables rated at 5 kV and with a 10,000-volt insulation-resistance test set for cable rated at 35 pr 46 kV. Test data shall be taken indicating phase to ground and phase to

phase Meg-ohm values for each cable comprising the circuit.

Test voltage shall be applied for long enough time to fully charge the cable. meg-ohm readings are to be recorded every 15 seconds during the first minute of test and then at 1 minute intervals thereafter up to a max of 10 minutes. Test may be terminated prior to 10 minutes if three equal readings, 1 minute apart, are obtained. Readings taken at other than 20 degrees C (68 degrees F) ambient temperature shall be temperature corrected in the final test report. Testing at greater that 90 percent humidity shall not be allowed without the concurrence of the Contracting Officer.

Upon successful completion of the dielectric absorption test, the cable shall be subject to a direct-current high-potential test using the Step Method. Test voltages shall be applied in accordance with AEIC C8 and IEEE Std 400.2 for ethylene propylene rubber-insulated cable.

(Note: Existing cables spliced to new cables shall not be subject to this test; however the new section(s) less the splice(s) are subject to this test.)

The test voltage shall be slowly applied in 5 increments of equal value up to the maximum specified. Maintain the test voltage at each step for one to two minutes in order to allow sufficient time for the leakage current to stabilize.

A leakage current reading is taken at the end of each interval before the voltage is raised to the next level. A plot of the test voltage versus insulation resistance is drawn as the test progresses. After the maximum test voltage is reached, a dielectric absorption test may be performed at that voltage, usually for a five minute period.

Leakage current readings shall be recorded every 30 seconds during the first 2 minutes and every minute thereafter for the remainder of the test. If the leakage current continues to increase after the first minute, the test shall be immediately terminated and steps taken to find and correct the problem. When a second test becomes necessary, this test procedure shall be repeated.

At the end of the test period, set the test set voltage to zero, allow the residual voltage on the circuit to decay, and then ground the conductor just tested.

After testing, maintain solid grounds on the cable for at least 4 times the duration of the test since dc charges can build up on the cable to potentially dangerous levels if grounds are removed too quickly. On exceptionally long cable lengths, it may be necessary the increase the grounding time. It is also advantageous to maintain these grounds longer and while reconnecting circuit components.

Note: Some common problems that may be encountered during testing and which must be guarded against during testing are listed below:

Extra Leakage Current:
- Failure to guard against corona
- Failure to clean insulation surface
- Failure to keep cable ends dry
- Failure to provide adequate clearance to ground
- Improper shield termination

Erratic Readings:
Fluctuating voltage to test set
Improper test leads
Environmental Influences:
High Relative Humidity
Dampness, Dew, Fog
Wind, Snow

Upon satisfactory completion of the high-potential test, give the cable a second dielectric-absorption test (Post High Potential Test) as before.

Results of the second dielectric-absorption test shall agree with the first test and shall indicate no evidence of permanent injury to the cable caused by the high-potential test.

Test data shall be recorded and include identification of cable and location, megohm reading versus time, leakage current reading versus time, cable temperature, humidity, test equipment used, and signed/printed name of tester.

No cable shall be energized until recorded test data have been approved by the Contracting Officer.

Following successful cable testing, test results shall be furnished to the Contracting Officer for submission to the Glenn Research Center High Voltage Electric Power System Manager (GRC HVEPSM) for approval. If the test result are found acceptable, the GRC HVEPSM will issue written approval to the GRC Power Dispatch for energization of the cable for the sole purpose of phasing and phase rotation testing of the cable.

3.2.1 Electrical Phase Rotation Testing

2.0 Electrical Phasing and Phase Identification

a) Electrical phase identification in the NASA/LeRC electric power system is 1 - 2 - 3.

b) Electrical phase rotation in the NASA/LeRC electric power system is clockwise in a 1 - 2- 3 sequence.

c) The physical arrangement of electrical phases installed at NASA/LeRC shall be in accordance with the following:

Top to Bottom (referenced from the front of the terminal box, front of switchboard, etc.):
Top: Phase 1;
Middle: Phase 2;
Bottom: Phase 3.

Front to Back (referenced from the front of the terminal box, front of switchboard, etc.):
Front: Phase 1;
Middle: Phase 2;
Back: Phase 3.

Left to Right: (referenced from the front of the terminal box, front of switchboard, etc.):
Left: Phase 1;
Middle: Phase 2;

Right: Phase 3.

a) In the device at the supply end of a new cable section, identify which conductor is to be connected to Phase 1; identify which position (top, front, left) the conductor will occupy. At the other end of the cable identify the position in the device (top, front, left) that phase will occupy. Perform a continuity test (Appendix A). After confirming continuity of the conductor, permanently tag both ends of the conductor as Phase 1.

b) In the device at the supply end of a new cable section, identify which conductor is to be connected to Phase 2; identify which position (middle) the conductor will occupy. At the other end of the cable identify the position in the device (middle) that phase will occupy. Perform a continuity test (Appendix A). After confirming continuity of the conductor, permanently tag both ends of the conductor as Phase 2.

c) In the device at the supply end of a new cable section, identify which conductor is to be connected to Phase 3; identify which position (bottom, back, right) the conductor will occupy. At the other end of the cable identify the position in the device (bottom, back, right) that phase will occupy. Perform a continuity test (Appendix A). After confirming continuity of the conductor, permanently tag both ends of the conductor as Phase 3.

d)For a cable section having fourth conductor for a neutral, perform a continuity test (Appendix A). After confirming continuity of the conductor, connect both ends of the conductor to the proper terminals, permanently tag both ends of the conductor as Neutral.

e) At the load end of a new cable section, install new cable links as may be necessary. Permanently tag both ends of the cable with the NASA cable circuit name/number and date of installation.

The above steps shall be used to connect each new cable section.

After the new cable circuit has been electrically tested and connected, the continuity of all phases and neutrals shall be continuity tested for the new circuit between the supply end and the load end (Appendix A).

Note: The contract may require the contractor to perform other Acceptance Tests for transformers and mineral oil supplied. Such Acceptance Tests shall be satisfactorily completed prior to phase rotation tests.

Upon satisfactory testing results (Sections 3.1 - 3.4), power transformer windings can be connected to cables. Transformer terminals are specified for connection to:

Terminal	Connection
H1	High Voltage Phase 1
H2	High Voltage Phase 2
H3	High Voltage Phase 3
X1	Low Voltage Phase 1
X2	Low Voltage Phase 2
X3	Low Voltage Phase 3

Under the following direction of the Government, new circuits may be connected to the electrical power system and energized. The transformer secondary must be electrically isolated from all loads for the following phase rotation test. This will be accomplished in one of the following ways:

a. Open the main circuit breaker for the new transformer at the switchboard. The phase rotation shall be measured on the transformer secondary.

b. At switchboards where there is no main circuit breaker for the new transformer, open all circuit breakers (including the bus tie breaker if applicable) connected to the bus to be fed by the new transformer. The phase rotation shall be measured on the transformer secondary.

Phase rotation shall be measured on the transformer secondary using a commercial phase rotation meter. The phase rotation shall be 1-2-3 in a clockwise rotation. At Single Transformer/Single Bus Sustations, switchboards, or panelboards, the electrical testing is complete.

In double-ended substations or double-ended switchboards, the electrical phase rotation shall also be measured on the secondary of the other transformer; the phase rotation shall be 1-2-3 in a clockwise rotation. Following successful measurement of both phase rotations, the voltage between the two transformer secondaries shall be measured:

Normal Supply (Phase)	Alternate Supply (Phase)	Voltage (Approximate) (volts ac)
1	1	0
1	2	Line-to-Line
1	3	Line-to-Line
2	1	Line-to-Line
2	2	0
2	3	Line-to-Line
3	1	Line-to-Line
3	2	Line-to-Line
3	3	0

Following successful phasing and phase rotation testing, with the written approval of the GRC HVEPSM, the cable is to be energized uploaded for a period of 24 hrs. prior to releasing the cable for service. This initial operational test period (termed "soaking") is used to determine if there are any imperfections in the installation that were not initially brought out during the dielectric and high potential testing of the installed cable including it's termination and splices.

Final acceptance depends upon, not only the satisfactory performance of the cable under test, but also on the GRC HVEPSM having receipt of the contractor's final test reports as of approved by the Contractor Officer.

Provide final test reports to the Contracting Officer. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and words "Final Test Report - Forward to the System Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

Rework or replacement of unacceptable terminations, splices, or cable is at no additional expense to the Government.

-- End of Section --

SECTION 26 05 19.00 10

INSULATED WIRE AND CABLE
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.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV
AEIC CS8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 383	(2003; R 2008) Standard for Qualifying Class 1E Electric Cables and, Field Splices for Nuclear Power Generating Stations 2004

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 70	(2009) Power Cable Rated 2000 V or Less for the Distribution of Electrical Energy--S95-658

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.Information only. 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:

SD-03 Product Data

Installation Instructions

SD-06 Test Reports

Tests, Inspections, and Verifications

1.3 DELIVERY, STORAGE, AND HANDLING

Furnish cables on reels or coils. Each cable and the outside of each reel or coil, shall be plainly marked or tagged to indicate the cable length, voltage rating, conductor size, and manufacturer's lot number and reel number. Each coil or reel of cable shall contain only one continuous

cable without splices. Cables for exclusively dc applications, as specified in paragraph HIGH VOLTAGE TEST SOURCE, shall be identified as such. Shielded cables rated 2,001 volts and above shall be reeled and marked in accordance with Section I of AEIC C8 or AEIC CS8, as applicable. Reels shall remain the property of the Contractor.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Wire Table

Furnish wire and cable in accordance with the requirements of the wire table appended to these specifications, conforming to the detailed requirements specified herein.

2.1.2 Rated Circuit Voltages

All wire and cable shall have minimum rated circuit voltages in accordance with NEMA WC 70.

2.1.3 Conductors

2.1.3.1 Material for Conductors

Conductors shall conform to all the applicable requirements of NEMA WC 70, as applicable, and shall be annealed copper. Copper conductors may be bare, or tin- or lead-alloy-coated, if required by the type of insulation used.

2.1.3.2 Size

Minimum wire size shall be No. 12 AWG for power and lighting circuits; No. 10 AWG for current transformer secondary circuits; No. 14 AWG for potential transformer, relaying, and control circuits; No. 16 AWG for annunciator circuits; and No. 19 AWG for alarm circuits. Minimum wire sizes for rated circuit voltages of 2,001 volts and above shall not be less than those listed for the applicable voltage in NEMA WC 70, as applicable.

2.1.3.3 Stranding

Conductor stranding classes cited herein shall be as defined in NEMA WC 70, as applicable. Lighting conductors No. 10 AWG and smaller shall be solid or have Class B stranding. Any conductors used between stationary and moving devices, such as hinged doors or panels, shall have Class H or K stranding. All other conductors shall have Class B or C stranding, except that conductors shown on the drawings, or in the schedule, as No. 12 AWG may be 19 strands of No. 25 AWG, and conductors shown as No. 10 AWG may be 19 strands of No. 22 AWG.

2.1.3.4 Conductor Shielding

Use conductor shielding conforming to NEMA WC 70, as applicable, on power cables having a rated circuit voltage above 2,000 volts. In addition, conductor shielding for shielded cables shall also comply with Section C of AEIC C8 or AEIC CS8. Strict precautions shall be taken after application of the conductor shielding to prevent the inclusion of voids or contamination between the conductor shielding and the subsequently

applied insulation.

2.1.3.5 Separator Tape

Where conductor shielding, strand filling, or other special conductor treatment is not required, a separator tape between conductor and insulation is permitted.

2.1.4 Insulation

2.1.4.1 Insulation Material

Provide insulation which is a cross-linked thermosetting polyethylene (XLPE) type, meeting the requirements of NEMA WC 70, as applicable, or an ethylene-propylene rubber (EPR) type meeting the requirements of NEMA WC 70. For shielded cables of rated circuit voltages above 2,000 volts, the following provisions shall also apply:

a. XLPE, if used, shall be tree-retardant.

b. Insulation shall be chemically bonded to conductor shielding.

c. The insulation material and its manufacturing, handling, extrusion and vulcanizing processes, shall all be subject to strict procedures to prevent the inclusion of voids, contamination, or other irregularities on or in the insulation. Insulation material shall be inspected for voids and contaminants. Inspection methods, and maximum allowable void and contaminant content shall be in accordance with Section B of AEIC C8 or AEIC CS8, as applicable.

d. Cables with repaired insulation defects discovered during factory testing, or with splices or insulation joints, are not acceptable unless specifically approved.

2.1.4.2 Insulation Thickness

The insulation thickness for each conductor shall be based on its rated circuit voltage.

a. Power Cables/Single-Conductor Control Cables, 2,000 Volts and Below - The insulation thickness for single-conductor cables rated 2,000 volts and below shall be as required by NEMA WC 70, as applicable. Some thicknesses of NEMA WC 70 will be permitted only for single-conductor cross-linked thermosetting polyethylene insulated cables without a jacket. NEMA WC 70 ethylene-propylene rubber-insulated conductors shall have a jacket.

b. Power Cables, Rated 2,001 Volts and Above - Thickness of insulation for power cables rated 2,001 volts and above shall be in accordance with the following:

(1) Non-shielded cables, 2,001 to 5,000 volts, shall comply with NEMA WC 70, as applicable.

(2) Shielded cables rated 2,001 volts and above shall comply with Column B of Table B1, of AEIC C8 or AEIC CS8, as applicable.

c. Multiple-Conductor Control Cables - The insulation thickness of multiple-conductor cables used for control and related purposes shall

be as required by NEMA WC 70, as applicable.

2.1.4.3 Insulation Shielding

Unless otherwise specified, provide insulation shielding for conductors having rated circuit voltages of 2,001 volts and above. The voltage limits above which insulation shielding is required, and the material requirements, are given in NEMA WC 70, as applicable. The material, if thermosetting, shall meet the wafer boil test requirements as described in Section D of AEIC C8 or AEIC CS8, as applicable. The method of shielding shall be in accordance with the current practice of the industry; however, the application process shall include strict precautions to prevent voids or contamination between the insulation and the nonmetallic component. Voids, protrusions, and indentations of the shield shall not exceed the maximum allowances specified in Section C of AEIC C8 or AEIC CS8, as applicable. The cable shall be capable of operating without damage or excessive temperature when the shield is grounded at both ends of each conductor. All components of the shielding system shall remain tightly applied to the components they enclose after handling and installation in accordance with the manufacturer's recommendations. Shielding systems which require heat to remove will not be permitted unless specifically approved.

2.1.5 Jackets

All cables shall have jackets meeting the requirements of NEMA WC 70, as applicable, and as specified herein. Individual conductors of multiple-conductor cables shall be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, shall be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables shall be provided with a common overall jacket, which shall be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

2.1.5.1 Jacket Material

The jacket shall be one of the materials listed below. Polyvinyl chloride compounds will not be permitted. Variations from the materials required below will be permitted only if approved for each specific use, upon submittal of sufficient data to prove that they exceed all specified requirements for the particular application.

a. General Use

(1) Heavy-duty black neoprene (NEMA WC 70).

(2) Heavy-duty chlorosulfonated polyethylene (NEMA WC 70).

(3) Heavy-duty cross-linked (thermoset) chlorinated polyethylene (NEMA WC 70).

b. Accessible Use Only, 2,000 Volts or Less - Cables installed where they are entirely accessible, such as cable trays and raceways with removable covers, or where they pass through less than 10 feet of

exposed conduit only, shall have jackets of one of the materials specified in above paragraph GENERAL USE, or the jackets may be of one of the following:

(1) General-purpose neoprene (NEMA WC 70).

(2) Black polyethylene (NEMA WC 70).

(3) Thermoplastic chlorinated polyethylene (NEMA WC 70).

2.1.5.2 Jacket Thickness

The minimum thickness of the jackets at any point shall be not less than 80 percent of the respective nominal thicknesses specified below.

a. Multiple-Conductor Cables - Thickness of the jackets of the individual conductors of multiple-conductor cables shall be as required by NEMA WC 70, and shall be in addition to the conductor insulation thickness required by Column B of Table 3-1 of the applicable NEMA publication for the insulation used. Thickness of the outer jackets or sheaths of the assembled multiple-conductor cables shall be as required by NEMA WC 70.

b. Single-Conductor Cables - Single-conductor cables, if nonshielded, shall have a jacket thickness as specified in NEMA WC 70. If shielded, the jacket thickness shall be in accordance with the requirements of NEMA WC 70.

2.1.6 Metal-Clad Cable

2.1.6.1 General

The metallic covering shall be corrugated metal, conforming to the applicable requirements of NEMA WC 70. If the covering is of ferrous metal, it shall be galvanized. Copper grounding conductor(s) conforming to NEMA WC 70 shall be furnished for each multiple-conductor metal-clad cable. Assembly and cabling shall be as specified in paragraph CABLING. The metallic covering shall be applied over an inner jacket or filler tape. The cable shall be assembled so that the metallic covering will be tightly bound over a firm core.

2.1.6.2 Jackets

Metal-clad cables may have a jacket under the armor, and shall have a jacket over the armor. Jackets shall comply with the requirements of NEMA WC 70. The outer jacket for the metal-clad cable may be of polyvinyl chloride only if specifically approved.

2.2 CABLE IDENTIFICATION

2.2.1 Color-Coding

Insulation of individual conductors of multiple-conductor cables shall be color-coded in accordance with NEMA WC 70, except that colored braids will not be permitted. Only one color-code method shall be used for each cable construction type. Control cable color-coding shall be in accordance with NEMA WC 70. Power cable color-coding shall be black for Phase A, red for Phase B, blue for Phase C, white for grounded neutral, and green for an insulated grounding conductor, if included.

2.2.2 Shielded Cables Rated 2,001 Volts and Above

Marking shall be in accordance with Section H of AEIC C8 or AEIC CS8, as applicable.

2.2.3 Cabling

Individual conductors of multiple-conductor cables shall be assembled with flame-and moisture-resistant fillers, binders, and a lay conforming to NEMA WC 70, except that flat twin cables will not be permitted. Fillers shall be used in the interstices of multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross section. Fillers shall be non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber-filled or other approved type of binding tape shall consist of a material that is compatible with the other components of the cable and shall be lapped at least 10 percent of its width.

2.2.4 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables shall not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

Submit cable manufacturing data . The following information shall be provided by the cable manufacturer for each size, conductor quantity, and type of cable furnished:

a. Minimum bending radius, in inches - For multiple-conductor cables, this information shall be provided for both the individual conductors and the multiple-conductor cable.

b. Pulling tension and sidewall pressure limits, in pounds.

c. Instructions for stripping semiconducting insulation shields, if furnished, with minimum effort without damaging the insulation.

d. Upon request, compatibility of cable materials and construction with specific materials and hardware manufactured by others shall be stated. Also, if requested, recommendations shall be provided for various cable operations, including installing, splicing, terminating, etc.

3.2 TESTS, INSPECTIONS, AND VERIFICATIONS

3.2.1 Cable Data

Manufacture of the wire and cable shall not be started until all materials to be used in the fabrication of the finished wire or cable have been approved by the Contracting Officer. Cable data shall be submitted for approval including dimensioned sketches showing cable construction, and sufficient additional data to show that these specifications will be satisfied.

3.2.2 Inspection and Tests

Inspection and tests of wire and cable furnished under these specifications shall be made by and at the plant of the manufacturer, and shall be witnessed by the Contracting Officer or his authorized representative, unless waived in writing. The Government may perform further tests before or after installation. Testing in general shall comply with NEMA WC 70. Specific tests required for particular materials, components, and completed cables shall be as specified in the sections of the above standards applicable to those materials, components, and cable types. Tests shall also be performed in accordance with the additional requirements specified below. Submit 2 certified copies of test reports.

3.2.2.1 High-Voltage Test Source

Where the applicable standards allow a choice, high-voltage tests for cables to be used exclusively on dc circuits shall be made with dc test voltages. Cables to be used exclusively on ac circuits shall be tested with ac test voltages. If both ac and dc will be present, on either the same or separate conductors of the cable, ac test voltages shall be used.

3.2.2.2 Shielded Cables Rated 2,001 Volts or Greater

The following tests shall be performed in addition to those specified above. Section or paragraph references are to AEIC C8 or AEIC CS8 as applicable, unless otherwise stated.

a. High potential test voltages shall be as required by Table B1 of AEIC C8 or AEIC CS8 as applicable, rather than by NEMA WC 70.

b. If high potential testing is done with an ac test voltage as specified in paragraph HIGH-VOLTAGE TEST SOURCE, an additional test shall be made using a dc test voltage rated at 75 percent of the specified full dc test voltage, for 5 consecutive minutes.

c. Production sampling tests shall be performed in accordance with Section D. Sampling frequency and failure contingencies shall be in accordance with paragraph G.3. Unless otherwise approved, samples shall not be taken from the middle of extruder runs of insulation or shielding made only for one continuous shipping length of cable, if such sampling will result in the need to repair the sampled area.

d. Partial discharge tests shall be performed in accordance with Section E, paragraph E.2, and Section F.

3.2.2.3 Flame Tests

All multiple-conductor and single-conductor cable assemblies shall pass IEEE 383 flame tests, paragraph 2.5, using the ribbon gas burner. Single-conductor cables and individual conductors of multiple-conductor cables shall pass the flame test of NEMA WC 70. If such tests, however, have previously been made on identical cables, these tests need not be repeated. Instead, certified reports of the original qualifying tests shall be submitted. In this case the reports furnished under paragraph REPORTS, shall verify that all of each cable's materials, construction, and dimensions are the same as those in the qualifying tests.

3.2.2.4 Independent Tests

The Government may at any time make visual inspections, continuity or resistance checks, insulation resistance readings, power factor tests, or dc high-potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with acceptable values for the application, will be grounds for rejection of the cable.

3.2.2.5 Reports

Furnish results of tests made. No wire or cable shall be shipped until authorized. Lot number and reel or coil number of wire and cable tested shall be indicated on the test reports.

WIRE TABLE

Item No.	Size, AWG or kcmil	No. of Conds.	Rated Circuit Voltage	Stranding	Comments	Quantity lin ft.

Class ___ stranding may be substituted for ___ where indicated by "*".

-- 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

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. Structural requirements shall be in accordance with Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

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:

High Voltage Breakers

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.

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.

High Voltage Breakers

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. 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:

SD-02 Shop Drawings

2.4kV Switchgear
34.5 Breakers

SD-03 Product Data

2.4kV Switchgear; G
34.5 kV Breakers; G
Contractor Designed Bracing; G

PART 2 PRODUCTS

2.1 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe in accordance with Section 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

-- End of Section --

SECTION 26 12 00.00 98

MEDIUM-VOLTAGE TRANSFORMERS, OIL FILLED
11/12

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C57.12.00	(2006) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
ANSI C57.12.10	(1997) Safety Requirements for Transformers, 280 kV and Below; 833/958 through 8,333/10,417 kVA, Single- Phase and 750/862 through 60,000/80,000/100,000 kVA, Three-Phase without Load Tap Changing; and 3,750/4,687 through 60,000/80,000/100,000 kVA with Load Tap Changing
ANSI C57.12.90	(2006) Test Code for Liquid-Immersed Distribution, Power and Regulating Transformers and Guide for Short-Circuit Testing of Distribution Power Transformers

ASTM INTERNATIONAL (ASTM)

ASTM A 345	(2004) Standard Specification for Flat-Rolled Electrical Steels for Magnetic Applications
ASTM B 48	(2000; R 2005e1) Standard Specification for Soft Rectangular and Square Bare Copper Wire for Electrical Conductors
ASTM D 117	(2002) Standard Guide for Sampling, Test Methods, Specifications and Guide for Electrical Insulating Oils of Petroleum Origin
ASTM D 1533	(2000; R 2005) Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration
ASTM D 3487	(2008) Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus
ASTM D 877	(2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

ASTM D 92	(2005a) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM D 924	(2008) Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids
ASTM D 974	(2008) Standard Test Method for Acid and Base Number by Color-Indicator Titration

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.12.00	(2006) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.90	(2006) Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE Std 57.19.00	(2004) Standard General Requirements and Test Procedures for Outdoor Apparatus Bushings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007; AMD 1 2008) National Electrical Code - 2008 Edition

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 98, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Data

Equipment and Performance Data shall be submitted for Distribution Transformers including resistance measurements, impedance, and voltage and load losses at rated currents.

Equipment Foundation Data for Distribution Transformers shall 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.

SD-02 Drawings

Connection Diagrams shall be submitted for Transformers 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.

Fabrication Drawings shall be submitted for Distribution Transformers consisting of fabrication and assembly details to be performed in the factory.

Installation Drawings shall be submitted for Distribution Transformers in accordance with the paragraph entitled, "Installation," of this section.

SD-06 Test Report

Submit Factory Test Reports for the following tests on power transformers in accordance with IEEE C57.12.90, Table 16.

High-Voltage Tests
Insulation-Resistance Test
Temperature-Rise Tests
Insulation Power Factor
Oil Power Factor
Impulse Tests
Impedance and Load Losses
Sound Tests
Bushing Tests

SD-07 Certificates

Certificates of Compliance of previous tests on similar units (type-testing) under actual conditions may be submitted for temperature-rise tests, bushing tests, impulse tests, and short-circuit tests in lieu of factory tests on actual units furnished.

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions for the Power Transformers including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Submit Field Test Reports for the following tests on power transformers in accordance with the paragraph entitled, "Field Testing" of this section.

Insulation Power Factor
Oil Power Factor
Oil Acidity Test
Water-in-oil (Karl Fischer) Test
Dissolved Gas Analysis
Turns Ratio Tests
Insulation Resistance Tests

1.4 QUALIFICATION TESTING

Tests on transformers shall comprise the manufacturer's standard tests including resistance measurements of all windings; ratio tests; polarity and phase-relation tests; no-load loss at rated voltage; impedance;

voltage and load loss at rated current; dielectric tests; excitation current at rated voltage; and the power factor insulation resistance test.

Maximum acceptable Doble Test value is 0.5. Tests shall be conducted in accordance with IEEE C57.12.90. No transformer shall be shipped to site until all factory tests and their results are approved by the Contracting Officer and the equipment is inspected and approved by the Contracting Officer unless the Government has given the manufacturer a written waiver. The Government reserves the right to witness any or all factory tests. Notification of impending tests shall be made two weeks prior to test date.

After the transformer arrives on site, the Meggar Test and Doble Test will be performed and an oil sample taken for a dielectric test and PCB content determination.

PART 2 PRODUCTS

2.1 EQUIPMENT STANDARDS

Windings shall be of copper construction.

The color shall be ANSI 70, grey.

Stainless steel nameplates shall be provided with the following information inscribed as appropriate:

- Serial number
- Class (cooling system)
- Number of phases
- Frequency
- Continuous/Forced air kVA ratings
- Voltage ratings with connection diagrams
- Tap voltages
- Temperature rise, degrees C
- Vector diagram
- Impulse level (full wave in kV)
- Percent impedance at nominal MVA
- Weight of core and coils
- Weight of tank and fittings
- Untanking weight of heaviest piece
- Weight of insulating fluid
- Total weight
- Gallons of insulating fluid (main tank and LTC compartment)
- Identification of insulating fluid
- Instruction book reference
- Name of manufacturer
- Date of manufacture

2.2 SPECIFIC REQUIREMENTS

2.2.1 Substation Transformers (501 kVA and Above)

Substation transformers rated 501 kVA and above shall conform to ANSI C57.12.00 and ANSI C57.12.10.

Salient Characteristics:

a. Type: Liquid-filled

b.	Location:	Outdoor
c.	Capacity:	
	1. Average ambient temperature:	30 degrees C
	2. Maximum ambient temperature:	40 degrees C
	3. Average winding temperature rise:	65 degrees C
	4. Load rating	kVA shown on drawings
	5. Forced air cooling	As indicated on drawings
d.	High voltage winding/compartment:	
	1. Nominal voltage:	34500 V
	2. Basic impulse voltage:	200 kV
	3. Winding connection:	Ungrounded Wye
	4. System connection:	Delta
	5. De-energized taps above nominal voltage:	2-2.5%
	6. De-energized taps below nominal voltage:	2-2.5%
	7. High voltage terminations:	NEMA 2-hole pad
	8. Surge arresters (Station Class):	31.5 kV MCOV
e.	Low voltage winding/compartment:	
	1. Nominal voltage:	2400V
	2. Basic impulse voltage:	60 kV
	3. Winding connection:	Delta
	4. Tap changer under load with VT & controls:	
	a. Transformer B2	32-5/8% (plus/minus 10%)
	5. Low voltage terminations:	NEMA flat pad
f.	Angular displacement (high to low)	30 degrees
g.	Winding temperature monitor(4-20 mA)/alarm:	Qualitrol QT-104-250
h.	Oil temp Monitor (4-20/al)	Qualitrol QT-104-250
h.	Oil level gauge/alarm:	Qualitrol CAS-770-1
i.	Pressure relief device/alarm:	Qualitrol Series 208
j.	Sudden pressure relay (Xfmrs 10 MVA & over):	Qualitrol 909/910
k.	Pressure/vacuum gauge/alarm:	Qualitrol Series 70
l.	Annunciator:	12 point Rochester
m.	Oil preservation system:	Dry nitrogen
n.	Current transformers:	as indicated on drawings

2.3 CONSTRUCTION

Transformers shall include a core and coil assembly enclosed in a sealed airtight and oiltight tank, with accessories and auxiliary equipment as indicated and specified.

2.3.1 Tank

Walls, bottom, and cover of the transformer tank shall be fabricated from hot-rolled steel plate with cooling tubes radiators vertically mounted to the side walls of the tank.

Transformer tank shall be welded construction with rectangular base designed for rolling in the direction of the centerline of the bushing segments.

Tank shall have a manhole in the cover. Circular manholes shall be not less than 15 inches in diameter. Rectangular or oval manholes shall be not less than 10 by 16 inches.

Tank shall have a handhole in the cover. Circular handholes shall be not less than 6-inches diameter. Rectangular handholes shall be not less than 4-1/2-inches wide and shall have an area of not less than 65 square inches.

Lifting, moving, and jacking facilities shall be provided conforming to ANSI C57.12.10.

Transformer base shall be designed to provide natural draft ventilation under the transformer tank when the transformer is placed on a flat concrete foundation. Bottom of the transformer tank shall be undercoated with a heavy rubberized protective sealing material at least 1/32 inch thick.

Cooling tubes shall be welded into headers which in turn shall be welded into the transformer tank wall.

A sealed-tank oil-preservation system shall be provided that will seal the interior of the transformer from the atmosphere throughout temperatures ranging to 100 degrees C. Gas and oil volume shall remain constant with internal gas pressure not exceeding 10 pounds per square inch, gage (psig) positive or 8-psig negative. Provision shall be made for the relief of excessive internal pressure in the transformer tank, by the installation of a pressure relief valve. A nitrogen supply cylinder with regulators and pressure alarm contacts shall be provided.

Completely assembled transform shall be designed to withstand, without permanent deformation, a pressure 25 percent greater than the maximum operating pressure of the sealed-tank oil-preservation system.

Spare mounting gaskets shall be provided for all bushings, terminal chambers, handholes, and the gasket between the relief cover and flange on the pressure relief valve.

2.3.2 Bushings

Primary windings of the transformer shall be terminated in cover-mounted high-voltage bushings. Secondary windings of the transformer shall be terminated in sidewall bushings enclosed with throats or flanges that are an integral part of the transformer and terminal chambers for electrical connections to the underground distribution system. Insulation class of bushings shall be the same as the insulation class of the windings to which they are connected. Electrical characteristics of transformer bushings shall be in accordance with IEEE Std 57.19.00. Station class surge arrestors shall be installed in the primary termination compartment.

2.3.3 Cores

Cores shall be built up with laminated, nonaging, high-permeability, grain-oriented, cold-rolled, silicon sheet steel. Laminations shall be coated with an insulating file or finish to minimize eddy-current losses. Sheet steel shall conform to ASTM A 345.

2.3.4 Coils

High- and low-voltage coil sections shall consist of insulated copper conductors wound around core. Coil sections shall be concentric or rectangular to counteract forces incurred under short-circuit conditions and shall be provided with oil ducts to dissipate the heat generated in the windings. Coil sections shall be electrically connected together and to the respective terminal bushings of the transformer. Copper conductors in the high- and low-voltage coil sections shall conform to ASTM B 48, Type B for applications involving edgewise bending.

Primary winding of the transformer shall be equipped with four 2.5 percent full-capacity taps, two above and two below normal voltage, brought out to an externally operated manual tap changer. Tap changer handle shall be capable of being padlocked in each tap position and shall be operable when the transformer is deenergized.

2.3.5 Cooling Provisions

Transformer shall be equipped with automatically controlled fans to provide forced-air-cooled transformer ratings in accordance with ANSI C57.12.10. Equipment shall include a thermally operated control device, manually operated bypass switch, motor-driven fans, and electrical conduit and wire connections.

Provision shall be made for the future mounting of control cabinets, conduit, and fans.

Thermally operated control device shall consist of a top oil temperature relay with thermal element mounted in a well responsive to the top liquid-level temperature of the transformer.

Thermally operated control device shall consist of a hot-spot temperature relay with thermal element mounted in a well and a bushing type current transformer. Energy from the current transformer shall be added to the top oil temperature of the transformer to indicate the simulated hot-spot condition in one phase of the transformer winding.

Well shall conform to IEEE C57.12.00. Manually operated bypass switch shall be connected in parallel with the automatic control contacts and enclosed in a weatherproof cabinet located on the side of the transformer at a height not greater that 60-inches above the concrete foundation. Fan motors shall be 120 -volt, single-phase, 60 hertz, without centrifugal switch and shall be thermally protected.

2.3.6 Automatic Load-Tap Changing Equipment

Transformer shall be equipped with three-phase automatic load-tap changing equipment that shall provide 10 percent voltage adjustment in 16 equal steps above and below rated secondary voltage in accordance with ANSI C57.12.10.

Load-tap changing equipment shall consist of an arcing tap switch selector and arching switch, a motor-driving mechanism position indicator, and automatic control devices contained in weatherproof enclosures mounted on the sidewalls of the transformer tank.

Arcing tap switch selector and arcing switch shall be located in one or more oil-immersed welded steel plate compartments with removable, bolted, external access covers, drain and sampling valve, filling plug, and magnetic liquid-level gage. Provision shall be made for the escape of gas generated by the arcing contacts. Oil in the arcing switch compartment shall be isolated from the oil within the transformer tank.

Motor-drive mechanism shall be equipped with a 120-volt, single-phase, 60-hertz motor and hand crank for automatic and manual operation of the driving mechanism. Mechanically operated electric limit switches shall be provided to prevent overtravel beyond the maximum lower and raise positions.

Automatic control devices shall be housed in a weatherproof sheet metal cabinet with breather and hinged doors to provide access to the control devices. Provision shall be made for padlocks.

LTC Controller shall have the following features:

Adjustable Bandcenter
Adjustable Bandwidth
Line Drop Compensation, R and X Compensation
Selectable Outputs, Continuous or Pulsed
Reverse Power Operation, for Transformer LTC and Single-Phase Regulator applications
CT to VT Phasing Correction
Drag Hands Operation
Voltage Limits
Tap Position Limits
Runback
Sequential and Non-Sequential Operation
VT Ratio Correction
Tap Position Record
Auto/Off/Manual Switch Status
Alarm Contact Outputs (2)
Raise Output
Lower Output
20 Character LCD Display
Front Panel LEDS for Out-of-Band Raise, Out-of-Band Lower, Reverse Power Flow Rev Pwr Detected, CPU OK, Line Drop Compensation LDC in Effect and Voltage Reduction V/RED in Effect
Front RS-232 communications Port COM2
External Inhibit of Auto Tapchange (non-sequential)
Circulating Current Paralleling Method
Seal-In Output
Deadman Alarm Output
Programmable Alarm Output

Provision shall be made for the accurate alignment, positioning, and locking of arcing contacts in each tap position. When the load-tap changing equipment is on a tap position at or above rated secondary voltage, the transformer shall be capable of supplying its rated kVA.

2.4 INSULATING OIL

Insulating oil shall conform to ASTM D 3487 with inhibitor. Dielectric strength of transformer oils, when shipped, shall be not less than 28 kV when measured in accordance with ASTM D 117. Neutralization Number shall not be greater than .03 gm KOH/ml when measured in accordance with ASTM D 974. Emulsified water shall not exceed 25 ppm at 20 degrees C. When measured in accordance with ASTM D 1533. Power factor shall not exceed .5 percent at 20 degrees C when measured in accordance with ASTM D 924.

Transformer insulating liquid shall be a nonpropagating high fire point transformer liquid having a fire point not less than 300 degrees C when tested per ASTM D 92. Liquid shall have a dielectric strength not less than 33 kilovolts when tested in accordance with ASTM D 877 and NFPA 70.

2.5 ACCESSORIES

Transformer accessories shall include a liquid-level indicator,

liquid-temperature indicator, pressure/vacuum gage, drain and filter valves, ground pads, and identification plate. Transformer accessories and their locations shall conform to ANSI C57.12.10.

Nitrogen fill valve to be located above the transformers liquid level.

2.5.1 Space Heaters

Secondary cable termination compartment shall be equipped with externally energized space heaters to proved approximately 4 watts per square foot of outer surface area. Heaters shall be such that the power density does not exceed 4 watts per square inch of heater element surface. Heaters shall be rated at 240-volts for connection to 120-volts. Heaters shall be located at the lowest portion of each space to be heated. Terminals shall be covered. Thermostats shall be used to regulate the temperature.

All heater shall be installed and operable at the time of shipment so that the heaters can be operated immediately upon arrival at the site, during storage, or before installation. Connection locations shall be marked prominently on drawings and shipping covers and shall have temporary leads for storage operation. Leads shall be easily accessible without having to remove shipping protection.

2.5.2 External Voltage Source

All externally powered wiring to the switch shall be grouped together as much as possible and connected to a terminal block which shall be marked with a laminated plastic nameplate having 3/16-inch high white letters on a red background as follows:

DANGER - EXTERNAL VOLTAGE SOURCE

2.5.3 Miscellaneous

Transformer accessories shall include a liquid-level indicator, liquid-temperature indicator, pressure/vacuum gage, drain and filter valves, ground pads, and identification plate. Transformer accessories and their locations shall conform to ANSI C57.12.10.

Transformer kilovolt-ampere (kVa) ratings are continuous and shall be based on temperature-rise tests. Temperature limits shall not be exceeded when the transformer is delivering rated kVA output at rated secondary voltage in accordance with IEEE C57.12.00.

2.6 PAINTING

After fabrication, all exposed ferrous metal surfaces of the transformer and component equipment shall be cleaned and painted. The transformer shall have the standard finish by the manufacturer for most outdoor installations, ANSI 70 Sky Gray Finish (3 mils).

2.7 FACTORY TESTS

Factory test shall be performed in accordance with ANSI C57.12.90.

PART 3 EXECUTION

3.1 INSTALLATION

Transformers shall be installed as indicated and in accordance with the manufacturer's recommendations. Transformer tanks shall be grounded.

Installation Drawings shall be submitted for the secondary unit substation. Drawings shall include complete details of equipment layout and design.

3.2 FIELD TESTING

Primary winding of the transformer shall be disconnected from the power supply, and the secondary windings of the transformer shall be grounded, before conducting insulation and high-voltage test on primary windings.

Secondary winding of the transformer shall be disconnected from the secondary feeder cables, and the primary winding of the transformer shall be disconnected from the power supply and grounded, before conducting insulation and high-voltage tests on secondary windings.

Windings of the transformer shall be given an insulation-resistance test with a 10,000-volt insulation-resistance test set on 34.5 kV winding, 2400V on 2.4 kV winding.

Tests shall be applied for not less that 5 minutes and until 3 equal consecutive readings, 1 minute apart, are obtained. Reading shall be recorded every 30 seconds during the first 2 minutes and every minute thereafter. Minimum acceptable resistance shall be 100 megohms.

Upon satisfactory completion of the insulation resistance tests the transformer windings shall be given a insulation power factor test and an excitation test. Maximum acceptable power factor is 0.5 percent. Excitation results will vary due to the amount of iron and copper in the windings and are used for baselines only.

The transformer shall then be given a turns ratio test. Readings shall be within 1/2 percent of calculated.

Upon satisfactory completion of the above electrical tests the transformer shall then be given the following oil tests: power factor, neutralization number, Karl Fischer, Dissolved gas analysis, and dielectric. Results shall be as follows:

Power Factor	less than .5 percent at 20 degrees C
Karl Fischer	less than 25 ppm at 20 degrees C
Neutralization Number	less than .03 gm KOH/ml
Dielectric	greater than 33 kV
Dissolved Gas Combustibles	less than 1000 ppm total

Final acceptance shall depend upon the satisfactory performance of the equipment under test. Transformer shall not be energized until recorded test data have been approved by the Contracting Officer. Final test reports shall be provided to the Contracting Officer. Reports shall have a cover letter/sheet clearly marked with the System Name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

SECTION 33 75 00.00 98

5 AND 15 KV SWITCHGEAR ASSEMBLIES
09/12

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C57.13	(2003) Requirements for Instrument Transformers

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007) National Electrical Safety Code
IEEE C37.20.2	(1999) Standard for Metal-Clad and Station-Type Cubicle Switchgear
IEEE C37.90	(2005) Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C37.90.1	(2002) Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE Std 4	(1995) Standard Techniques for High Voltage Testing

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2008) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 467	(2007; 6th Ed; Nov 14, 1986) UL Standard for Safety Grounding and Bonding Equipment

1.2 SYSTEM DESCRIPTION

Section 26 00 00.00 98, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00.98, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Data

Equipment and Performance Data shall be submitted for Electrical Equipment consisting of the following:

One-line diagram of electrical equipment and system.

Spare Parts Data

SD-03 Data

Equipment Foundation Data for Switchgear Assemblies shall 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.

SD-03 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Switchgear Assemblies
Enclosures
Buses
Switchgear Components
Waterproof Enclosures
Automatic Throw-Over Operation Devices
Paint Materials
Space Heaters
Relay and Metering Systems

SD-02 Drawings

Connection Diagrams shall be submitted indicating the relations and connections of the following items by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal wiring and other devices.

Switchgear Assemblies
Buses
Switchgear Components
Space Heaters

SD-02 Drawings

Fabrication Drawings shall be submitted for the following items consisting of fabrication and assembly details to be performed in the factory.

Switchgear Assemblies
Enclosures
Buses
Switchgear Components
Waterproof Enclosures
Space Heaters
Relay and Metering Systems

SD-02 Drawings

Installation Drawings shall be submitted for the Switchgear Assemblies in accordance with the paragraph entitled,

"Installation," of this section. Drawings shall include complete details of equipment layout and design.

SD-08 Instructions

Manufacturer's Instructions shall be submitted for the Switchgear Assemblies including special provisions required to install equipment components and system packages. Special notices shall detail hazards, safety precautions, maintenance tasks, recommended maintenance task intervals, and installation instructions.

SD-06 Reports

Test Reports shall be submitted for the following tests on switchgear assemblies in accordance with the paragraphs entitled, "Field Testing" and "Relay Settings and Tests," of this section.

Electrical Acceptance Tests
High Voltage Tests
Insulation Resistance Tests
Weather Proofing Tests
Electrical Tests
Ratio and Polarity Tests

SD-07 Certificates

Certificates of Compliance shall be submitted showing evidence of the qualifications of the Registered Professional Electrical Engineer.

SD-10 Operational Maintenance Data

Switchgear assemblies shall not be energized until recorded test data have been approved by the Contracting Officer. Record copies of all vendor drawings shall be provided.

1.4 FACTORY TESTING

Factory tests on transformers and switchgear assemblies shall be made in accordance with the applicable provisions of the referenced standards.

The Government may inspect the switchgear assembly during fabrication and assembly and reserves the right to witness switchgear performance and verification tests. Notification of impending tests shall be made two weeks prior to the test date.

Tests on switchgear assemblies shall include mechanical operational tests, electrical operation and control-wiring tests, relaying and metering circuit performance tests, and dielectric tests. Tests shall be conducted in accordance with IEEE Std 4.

1.4.1 Certified Test Reports

The supplier shall provide two copies of a certified report of the required tests which demonstrate that the furnished equipment meets or exceeds the requirements. As a minimum, the test reports shall include the following information:

a. Name of Project

b. Location of Project
c. LeRC Contract Number
d. Name of Prime Contractor
e. Name and Signature of Responsible Person
f. Date of Report

For each test, provide:

a. Name of Test
b. Description of Test
c. Minimum Requirement(s) of Test
d. Name(s) of Testing Personnel
e. Date and Time of Test
f. Copy of all Test Results
g. Copy of calculations used to reduce the Data
h. Statement of Compliance with Test Result Requirements
i. Statement of non-compliance with Test Result Requirements

For instrumentation, provide:

a. Manufacturer, Type, Model Designation, Serial Number
b. Certification of Calibration
c. Copy of Calibration Certificate
d. Name and Address of Company Performing Calibration
e. Date of Calibration

Calibration of instrumentation shall be traceable to the National Bureau of Standards. Instruments must be calibrated within 12 months of use.

1.5 MANUFACTURER QUALIFICATIONS

Material and equipment to be provided under this specification shall be the standard catalog product of a manufacturer regularly engaged in the manufacture of switchgear assemblies and their component parts and equipment. Equipment shall be of the latest standard design for indoor or outdoor service and shall have been in repetitive manufacture for at least 150 units.

1.5.1 Engineering Services

A registered professional electrical engineer who specializes in relays and coordinating systems associated with electric-power apparatus for the manufacturer of the equipment, shall coordinate the set-up of all circuit-interrupting devices before the substation is energized. Duties and responsibilities of the engineer shall include the following work.

1.5.1 Preliminary Survey and System Coordination Study

Short-circuit calculations supplied by the Government shall be reviewed to verify the minimum and maximum values of short-circuits and their electrical characteristics. This information will be provide after Contract award.

One-line diagrams have been prepared by the Government that indicate, by means of single lines and simplified symbols, the course and component devices of an electric circuit or system of circuits and their electrical characteristics. This information will be provided after Contract award.

Equipment shall be inspected and the intended function of each

circuit-interrupting device and the manner in which it is connected shall be verified to provided a properly coordinated electrical power system under normal load and fault conditions.

Wiring diagrams furnished by the manufacturer shall be checked and compared with actual connections of the equipment to verify that each device is properly connected to perform its intended function.

1.6 WARRANTY

The manufacturer shall warrant the equipment to be free from defects for a period of one year following energization and the Government's final acceptance. Final acceptance will occur after field testing by an agent independent of the manufacturer has verified that the equipment meets the specification.

PART 2 PRODUCTS

2.1 EQUIPMENT STANDARDS

Switchgear assemblies shall conform to IEEE C37.20.2. The switchgear shall be designed with a minimum BIL of 60 kV.

2.2 CONSTRUCTION

2.2.1 Switchgear and Auxiliary Compartments

Switchgear assemblies and auxiliary equipment shall be metal clad stationary mounted in self-supporting, self-contained, sheet metal enclosures with hinged front and rear doors. Switchgear shall be complete number of vertical section bolted together to form a single line-up of metal-enclosed rigid equipment. Vertical section barriers, rear covers, and roofs will be 11-gauge epoxy powder coated steel. Equipment must be provided with lifting facilities.

Outdoor equipment will be enclosed in a weatherproof, gasketed steel housing. Access doors will have stops and provisions for padlocking. Interior lighting, receptacles, and convenience outlets shall be furnished. Space heaters to retard condensation shall be furnished. Floor plates shall be supplied with provision for the entrance of the cables and/or conduits.

All bus joints, taps, splices and outgoing connections shall be insulated. The manufacturer shall provide bolt-torquing instructions. Sheet metal compartments shall be joined together to form a continuous structure. Sheet metal barriers, enclosures, and external covers and doors shall be constructed from cold-rolled carbon-steel sheets of commercial quality not less than 1.9 mm, with stretcher-level flatness in accordance with ASTM A 366/A 366M. Internal covers in front of breaker, shall have a reinforced transparent cover so that the breaker status is visible.

Unit sheet metal shall enclose one or more vertically mounted power circuit breakers or auxiliary equipment in individual sheet metal compartments and a full height rear compartment. Housing shall be approximately 2.7 meter high with individual ventilated panels, top, and rear covers. Rear compartment shall contain the main bus, main bus-tap connections, cable connections, and instrument transformers. The exterior enclosure shall be weatherproof NEMA type 3R. The base of the switchgear

shall have steel beam construction for support on a concrete surface that is not fully level.

2.2.2 Compartment Details

Compartments shall be completely wired with cable terminals, cable clamps, control bus, control power switch, and terminal blocks. Terminal blocks shall be readily accessible for the external connections of metal-clad switchgear.

Low-voltage wiring for controls and accessories shall be run to terminal blocks having numbered points, to identify circuits. Low-voltage wiring shall be run in conduit or wiring raceways to isolate the wiring from high-voltage circuits. Wiring connections shall be identified.

Each compartment of the switchgear assembly shall be identified by an identification plate engraved with circuit and function designations.

Removable elements of the same type and rating in the switchgear assembly shall be physically and electrically interchangeable in corresponding compartments. Front-hinged panel shall be suitable for mounting instruments, relays, control switches, and indicating lamps.

Barriers between a sectionalized bus with bus sectionalizing breakers in a compartment shall be sheet steel not less than 11-gage. Other covers, barriers, panels, and doors shall be not less than 14-gage.

Each compartment shall be reinforced with structural members and welded together. Welds shall be ground to a smooth flat surface before painting.

All doors shall be hinged with formed welded edges and provided, as required, with doorstops and louvers. For outdoor applications, door with louvers shall include 3 mm mesh vermin screens. Door shall have a minimum of 105 degrees opening and be so designed that there will be no interference with devices when the circuit breakers are inserted or removed.

2.2.3 Buses

Switchgear assemblies shall be completely bussed utilizing electrical grade, high conductivity, solid copper bus bar having a rectangular cross section. Main, riser and bus tap connections shall be uniformly positioned and phase sequenced in accordance with IEEE C37.20.2. Busses shall be supported and braced to withstand both electrically and mechanically the short circuit current ratings.

Termination and connection points of all bus bar used in the switchgear shall be silver plated by an electroplating process. Silver coating methods that do not use the flow of electrical current as part of the process shall not be acceptable. After plating the contact surface shall not be sanded or otherwise abraded, but shall be cleaned with a soft cloth immediately prior to final assembly. Buses shall be rated 2000A.

All bus bar connections shall be made using silicon bronze bolts with wide flat silicon bronze washers under the bolt head and nut. These connections shall be tightened and checked by use of a calibrated torque wrench. Other connection designs may be used with the written agreement of the Contracting Officer.

Main bus shall be readily accessible for connection of future switchgear assemblies at either end. Main and auxiliary control drawout type connections shall be silver-to-silver contact, positive pressure, self-aligning, with enclosure-to-enclosure stationary mechanism when breaker is in drawout position.

Voltage rating and insulation level of switchgear assemblies shall conform to IEEE C37.20.2.

Temperature limits for buses and bus-tap connections in switchgear assemblies shall be in accordance with IEEE C37.20.2.

A continuous rigid copper ground bus shall extend throughout the entire assembly and shall ground the stationary structure and equipment. Ground bus shall be capable of carrying the rated short circuit current of the protective devices in the switchgear assembly for a minimum period of one second.

Compartments shall be completely wired with cable terminals, cable clamps, control bus, control power switch, and terminal blocks. Terminal blocks shall be readily accessible for the external connections of metal-clad switchgear.

Low-voltage wiring for controls and accessories shall be run to terminal blocks having numbered points, to identify circuits. Low-voltage wiring shall be run in conduit or wiring raceways to isolate the wiring from high-voltage circuits. Wiring connections shall be identified.

Each compartment of the switchgear assembly shall be identified by an identification plate engraved with circuit and function designations.

Metal-enclosed bus shall be of nonsegregated group phase construction and shall include rigid insulated conductors and supports in a grounded metal enclosure with associated ventilation and space-heater enclosures, condensation barriers, expansion and connection joints, and fittings in accordance with IEEE C37.20.2.

Enclosures shall be completely bused with an insulated solid rigid copper bus bar of rectangular cross section. Bus bar and connections shall be uniformly positioned and phase sequenced within the enclosure for adaptation to metal-clad switchgear assemblies and power transformers, in accordance with IEEE C37.20.2.

Bus bar shall be supported and braced to withstand short-circuit stresses with momentary current ratings, in accordance with IEEE C37.20.2. Contact surfaces of all bus connections shall be silverplated and bolted together to ensure maximum conductivity. Voltage and current ratings shall conform to IEEE C37.20.2.

Insulating supports shall consist of track-resistant, flame-retardant IEEE Class 130 electrical insulating materials. Voltage rating and insulation level shall conform to IEEE C37.20.2.

2.2.4 Weatherproof Construction

Switchgear assemblies for outdoor applications shall be weatherproof NEMA Type 3R enclosures, with ventilated front and rear-hinged doors, base, and roof sections. Access doors shall be flanged and shall close against rubber or similar gasketing material. Ventilated openings shall be

provided with filtered covers and screen vents for protection against the weather and insects. Doors shall be equipped with latch, stops, and door-locking mechanism.

Roof section shall be unit construction with removable sloping cover and overhanging rood drip edge. Base section shall be unit construction and shall support metal-enclosed switchgear 150 millimeter above the concrete foundation.

Switchgear enclosures shall include a removable steel floor plate which shall be drilled for conduit and cable during installation. Floor and roof of the switchgear shall be undercoated with a heavy rubberized protective sealing material at least 0.79 millimeter thick.

Each enclosure section shall be equipped with thermostatically controlled electric space heaters to minimize condensation. Provisions shall be made for terminating incoming and outgoing underground cables.

2.3 SWITCHGEAR COMPONENTS

2.3.1 Power Circuit Breakers

Power circuit breakers shall be 5 kV Class, 350 MVA fully draw out with an electrically-controlled and stored-energy-operated, three-pole, single-throw, removable element. The breakers shall be both electrically and mechanically trip-free in all positions of the closing sequence. The breaker operating mechanism shall have provisions for safe manual charging of the closing spring. The breaker mechanism shall be operable while the breaker is in the connected and test positions. The breaker shall be furnished with individual track rollers. Main and tie breakers shall be rated 2000A; feeder breakers shall be rated 1200A.

The circuit breakers shall use the vacuum interruption principle utilizing three independent vacuum bottles. Vacuum integrity shall be fully tested and certified prior to shipment of equipment. The breakers shall be VCP-W or equal.

The breaker compartment shall be furnished with a mechanism either electrically or manually operated to move the breaker between the operating, test, and disconnect positions. The mechanism shall be equipped with self-aligning and self-coupling primary and secondary disconnecting devices and will be rigidly held in the operating and test positions and in the disconnect position with the door closed. In the disconnect position, the breaker shall be easily removable from the compartment. Removing a front cover access plate shall make maintenance access to the circuit breaker spring charge mechanism possible. The access plate shall have a window of glass or plastic in it to provide visual status of the breaker.

Means shall be provided for padlocking the breaker in either the connected (operating) position or the disconnected position. When locked in the disconnected position, the breaker shall be removable from the compartment. Padlocking shall not interfere with breaker operation.

No primary circuit components shall be exposed when the unit door is open. An automatic shutter shall cover the stationary primary disconnecting contacts when the breaker is in the disconnected and test position or out of the housing with full air clearance to live parts.

Primary disconnecting contacts shall be silver-plated.

The voltage for circuit breaker control and closing spring charging shall be 125V dc supplied from an external source.

Permissible control voltages shall be as follows:

Closing and auxiliary functions:	100 - 140 V dc
Tripping functions:	70 - 140 V dc

Circuit breakers of equal ratings shall be interchangeable.

Four normally open (N.O.) and four normally closed (N.C.) auxiliary contacts directly actuated by the circuit breaker mechanism shall be provided in addition to any requirements of the switchgear manufacturer. These contacts shall be field convertible from N.O. to N.C. and vice verse. All auxiliary contacts shall be wired to terminal blocks.

Two N.O. and two N.C. auxiliary contacts directly actuated by the physical location of the breaker shall be provided. The auxiliary switch shall be mounted to the cubicle side wall and shall indicate if the breaker is in the connected position or has been retracted into the test/removed position. Contacts shall be wired to terminal blocks.

A mechanical operation counter shall be provided. Position indicators shall be provided to show whether the breaker is open or closed and in the connected, disconnected, and test positions.

Each circuit breaker shall be provided with a front-mounted close and trip device to operate the breaker in case of loss of control power.

Each circuit breaker shall be provided with Maintenance Test Switch.

Interlocks shall be provided on the circuit breaker as follows:

a. To prevent moving the movable element to or from the connected position when the circuit breaker is in the closed position.

b. To prevent closing the circuit breaker unless the primary disconnecting devices are in full contact or the circuit breaker is in the test position.

c. To prevent the complete withdrawal of the circuit breaker from the housing when the stored energy mechanism is charged.

d. To prevent the complete withdrawal of the circuit breaker until the closing function is blocked.

e. To automatically discharge the stored energy before withdrawing the circuit from the housing.

To prevent breakers of different ratings to be inserted into a compartment.

2.3.2 Current Transformers

Current transformers shall be the window type with fully distributed secondary windings. Unless indicated otherwise on the contract drawings each current transformer shall be mounted with polarity marks toward its

associated circuit breaker.

All current transformer terminals shall be accessible for testing. Short-circuiting-type terminal blocks shall be provided for current transformer secondaries.

The voltage withstand insulation levels, mechanical and thermal short-time ratings of each current transformer shall equal or exceed the equivalent ratings of its associated circuit breaker.

Current transformer ratios shall be protection class as indicated on the drawings with a minimum ANSI accuracy class rating of C200.

CT neutrals shall be grounded at one location, from a terminal block, to the ground bus.

Provide shorting clips on CT secondary terminal blocks.

CTs shall be multi-ratio as indicated.

2.3.3 Voltage Transformers

All voltage transformers furnished under this specification shall be mounted in a roll-out tray with integral primary current limiting fuses. Each set of voltage transformers shall be connected Y-Y with fuses and primary connections installed in a separate compartment with a hinged, latched door within the voltage transformer unit.

All voltage transformers (VTs) shall be ANSI accuracy class 0.3 W, X, Y, and Z and conform to ANSI C57.13.

Fuses shall be provided for all voltage transformer secondary circuits. Metering circuits shall be fused separately from relaying circuits. Secondary fuses shall be located in the same unit as the voltage transformer and shall be readily accessible for test and replacement.

The neutrals of the voltage transformers shall be grounded by connecting to the ground bus.

2.3.4 Relay and Control

All protective relays shall be installed on the front door of the switchgear units.

Unless specified otherwise, relays shall be solid state type. Solid-state relays shall pass the SWC test in accordance with IEEE C37.90.1.

Test switches shall be provided to isolate all tripping functions. The current circuit of solid-state relays shall be provided with Type FT-1 shorting-type test switches.

Each tripping element of all protective relays shall have individual operation indicators which can be manually reset without removing the relay cover.

All relays shall be rated 5 amperes, 120 volts and shall be suitable for operation with 125V dc control voltage. All protective relays and relays used for control, regulation, monitoring, and auxiliary tripping shall be designed and manufactured to meet all requirements of IEEE C37.90.

Manufacturers' types for each required relay function are identified on the drawings. The manufacturer shall not substitute other relays without written approval.

Unless otherwise specified, all auxiliary relays used for breaker control, and tripping shall have a minimum contact rating of 10 amperes continuous. Auxiliary relay coils and contacts shall be directly wired to the relay studs.

Auxiliary tripping relays shall have a maximum operating time of 16 ms at 125V dc.

All bus, transformer, and breaker failure lock-out protection shall operate a rotary-type multi-contact, hand-reset auxiliary tripping relay equipped with mechanical target and oval operating handle. All N.O. contacts of these relays shall be wired to test switches.

Breaker control switches shall be electrically operated, have pistol grip handles and include indicators which will identify the last position to which the switch was operated. All control switches shall be of the rotary spring return type. The contacts shall be silver to silver and shall enclosed with easily removable protective covers. The switch contacts shall be rated 20A continuous. Slip contacts "after trip" and "after close" shall be provided. Control switches shall be Electroswitch Type CSR or equivalent.

Three indicating lights shall be provided for each breaker to indicate the position of the breaker: The lamps shall be provided with a green-colored cap to indicate an open breaker; a red-colored cap to verify trip coil continuity and to indicate a closed breaker; and a white-colored cap to indicate a relay-initiated trip condition. The lamps shall be located above the associated breaker control switch.

An indicating light shall be provided with each hand-reset lock-out relay to verify the continuity of the relay coil. The lamp shall have an amber-colored cap.

An alarm relay and indicating light shall be provided for each dc control circuit which is not monitored by a solid-state protection relay.

Long-life, low-voltage, low-energy LED lights shall be provided for all indicating lamps.

Blocking diodes used in control circuits shall have a minimum PIV of 600V, a continuous rating of at least 1A, and a 30 second rating of 30A.

2.3.5 Metering

Digital metering devices shall be solid state and provided to monitor A; V; VA; W; VAR; KWHR; PF; HZ; DEMAND W, VARS A, VA as shown on the drawings with programming software. Meters shall be factory programmed and calibrated and are to provide 4-20 MA output for A, VA, W and VARS.

Current and voltage test switches shall be provided to isolate and test all meters on each circuit breaker position. Suitable types include Type FT-1.

2.3.6 Wiring (Internal to Switchgear)

The switchgear shall be wired for external connections in accordance with the drawings. Wiring shall include provisions for future remote control and other remote interfaces as indicated on the drawings.

All wiring shall conform to NEC requirements.

All control wiring shall be flame-resistant type SIS 90 degrees C. All control wiring shall be stranded copper, No. 14 AWG minimum. All power wiring shall be stranded copper, No. 12 AWG minimum. Current transformer secondary wiring shall be No. 10 AWG minimum. All control wiring in high-voltage compartments shall be enclosed in conduit or metallic armor and adequately supported. Extra flexible wire (65 strand) shall be used across hinges.

Wiring shall be so arranged that instruments or devices may be removed or serviced. No wire shall be routed across the face or rear of an instrument, junction box, or other device in a manner which will prevent the openings of covers or obstruct access to leads, terminal devices, or instruments.

All metering, relaying, and control wiring shall be terminated on terminal blocks mounted in the switchgear. All equipment auxiliary switch contacts shall be wired to terminal blocks whether used or not. Wiring shall be identified on both ends with heat shrinkable markers corresponding to the identification used on the schematic and wiring diagrams.

All wiring connections shall be made with ring tongue terminals with insulated ferrule. Spade or hook-type terminals are not acceptable.

Terminal blocks for external circuit connections shall be molded or fabricated with plastic with screw-type terminals for No. 10 machine screws and with barriers between the terminals. Pressure or clamp-type terminals are not acceptable. GE type EB-25, Marathon Series 1500 and Westinghouse Style No. 542247 are typical of the type of terminal blocks desired. The terminal blocks shall be suitable for terminating wires up to No. 10 AWG. At least 20 percent spare terminals shall be provided for each switchgear unit.

Terminal blocks shall be mounted only on the vertical walls of compartments.

Terminal blocks shall be identified by number, letter, or other symbol matching those used on the schematic and wiring diagrams.

CT terminal blocks shall be the shorting type.

Fuse holders shall be molded phenolic or porcelain rated 600 volts. Fuse clips shall be spring tension sufficient to maintain contact after repeated fuse replacement. Fuses shall be non-renewable rated 250V dc.

2.3.7 Nameplates

The manufacturer's nameplate shall be permanently stamped with the manufacturer's name, model number, type, serial number, unit voltage and current ratings, and shall be permanently affixed to the switchgear assembly. All other equipment shall be provided with nameplates as specified by the applicable ANSI standards.

Engraved laminated plastic nameplates (white face - black letters) for component and circuit identification shall be provided on the front and rear of each unit. Each instrument shall be provided with a nameplate. A minimum letter height of 5 mm shall be provided for nameplates that identify meters, relays, switches, and other similar devices. The nameplates shall be fastened to the panels either with stainless steel or brass machine screws or plastic snaps. Adhesives are not acceptable.

2.3.8 Interface Requirements

Terminal blocks used for field connections shall be configured in accordance with the drawings. All external field connections shall be shown on wiring diagrams produced by the manufacturer based on the specification drawings.

2.3.9 Accessories

The manufacturer shall provide all necessary devices required for operation and maintenance of the equipment including, but not limited to, the following:

a. One test cabinet and cable couplers suitable for wall mounting.

b. Two sets each of all necessary cranks, wrenches, or other tools required to manipulate the movable carriage structure, including maintenance closing lever.

c. One truck or dolly for breaker movement during maintenance.

d. Two test plugs of each type, as required, for all drawout relays and meters.

e. Two sets each of other special tools required for maintenance and/or repair.

f. Control jumpers, when required, to connect the secondary disconnecting device on the stationary structure to the removable element, when it is in the disconnected position, thereby permitting electrical operation of the circuit breaker. Each jumper shall consist of a receptacle and plug with flexible interconnecting cable.

g. One complete set of spare control fuses and VT fuses for each rating.

2.4 PAINTING

After fabrication, exposed ferrous-metal surfaces of switchgear assemblies and component equipment shall be prepared and painted.

Cleaning and phosphatizing treatment prior to the application of paint shall conform to FS TT-C-490. Hot-rolled steel sheet and plate shall be sand-, shot-, or grit-blasted to white metal to obtain a completely clean surface before phosphatizing. Cold-rolled steel sheet and plate shall be cleaned of all dirt, grease, and oil before phosphatizing.

Exterior surfaces, except the bottoms of transformers and weatherproof enclosures and interior surfaces, and machined parts, shall be given a

prime coat and two finish coats of paint. On bottom of transformers, use rubberized protection coating at least 1/32 inch thick.

Prime coat paint shall be zinc chromate in an alkyd vehicle conforming to FS TT-P-645.

Finish coat paint shall be pigmented alkyd gloss enamel conforming to FS TT-E-489. Color of exterior finishes outdoors shall be ANSI 70 gray. Color shall conform to FED-STD 595.

Interior surfaces, except machined parts, shall be given a prime coat and two finish coats of paint. Prime coat paint shall be zinc chromate in an alkyd vehicle conforming to FS TT-P-645. Finish coat paint shall be pigmented alkyd gloss enamel conforming to FS TT-E-489. Color of finish shall be No. 16473, metallic gray in accordance with FED-STD 595. ARC flash warning labels shall be placed on each cubicle door.

2.5 SPACE HEATERS

Each section of outdoor switchgear shall be equipped with externally energized space heaters to provide approximately 4 watts per square foot of outer surface area. Heaters shall be such that the power density does not exceed 4 watts per square inch of heater element surface. Heaters shall be rated at 208 or 240 volts for connection to a 120 volt system. Heaters shall be located at the lowest portion of each space to be heated. Terminals shall be covered. Thermostats shall be used to regulate the temperature.

All heaters shall be installed and operable at the time of shipment so that the heaters can be operated immediately upon arrival at the site, during storage, or before installation. Connection locations shall be marked prominently on drawings and shipping covers and shall have temporary leads for storage operation. Leads shall be easily accessible without having to remove shipping protection.

2.6 EXTERNAL VOLTAGE SOURCE

All externally powered wiring to the switchgear shall be grouped together as much as possible and connected to a terminal block which shall be marked with a laminated plastic nameplate having high white letters on a red background as follows:

DANGER - EXTERNAL VOLTAGE SOURCE

Externally powered wiring will include 120-volt unit space heaters and 125V dc controls.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall conform to IEEE C2 and NFPA 70.

Complete assembly shall be electrically and mechanically connected together at the site from coordinated subassemblies shipped in complete sections from the manufacturer. Installation shall be carefully aligned, leveled, and secured to the foundation and shall conform to the manufacturer's recommendations.

Noncurrent carrying parts and enclosures of the switchgear shall be bonded together and grounded to a driven ground with a maximum resistance to ground of 20 ohms. Ground connections shall be exothermically welded in accordance with UL 467. Minimum size of ground conductor shall be 4/0 AWG.

Switchgear shall be provided with an earth ground resistance pad as shown on the drawings. Switchgear resistance to ground shall not exceed the following values:

5,000 kVA and above	3 ohms
1,000 kVA to 5,000 kVA	5 ohms
1,000 kVA and below	10 ohms

Switchgear assemblies split for shipping shall be carefully joined to present a neat appearance, and main and ground bus joints shall be tight. Assemblies shall be handled with lifting devices.

3.2 FIELD TESTING

Main bus of switchgear assemblies shall be subjected to insulation resistance and high-voltage, 60-hertz withstand tests after installation is completed and ready for operation.

Test equipment, labor, and technical assistance shall be provided to perform the electrical acceptance tests as herein specified. Test equipment shall have calibration certificate not more than one year old.

Incoming section main bus shall be disconnected from the power supply and primary feeder cables, and the switchgear enclosure shall be grounded before the insulation and high-voltage tests are conducted.

Outgoing section main bus shall be disconnected from the secondary feeder cables and disconnected from the power supply and primary feeder cables. Switchgear enclosure shall be grounded before conducting insulation and high-voltage tests.

Main bus of the incoming section shall be given an insulation-resistance test with a 5,000-volt insulation-resistance test set.

Main bus of the outgoing section shall be given an insulation-resistance test with a 5,000-volt insulation-resistance test set.

Test shall be applied for not less than five minutes and until three equal consecutive readings, one minute apart, are obtained. Readings shall be recorded every 30 seconds during the first two minutes and every minute thereafter. Minimum acceptable resistance reading shall be 100 megohms.

Upon satisfactory completion of the insulation-resistance test, the main bus shall be subjected to a high-voltage (hi-pot) withstand test. Test voltage shall be equal to 75 percent for dc of the values shown in IEEE C37.20.2 for metal-clad switchgear and metal-enclosed low-voltage power-circuit-breaker switchgear. Test shall be applied for one minute.

Upon satisfactory completion of the high-voltage withstand test, the main bus shall be given a second insulation-resistance test as before. Results of the second test shall be within five percent of the first test and shall indicate no evidence of permanent injury by the high-potential test.

Tests on switchgear assemblies shall include electrical and mechanical operational tests, control-wiring tests, relaying and metering circuit performance tests, and dielectric tests. Tests shall be conducted in accordance with IEEE Std 4.

Final acceptance shall depend upon the satisfactory performance of the equipment under test.

3.3 RELAY SETTINGS AND TESTS

The purchaser reserves the right to inspect the equipment during manufacture and prior to shipment. Travel and living expenses for visits to the manufacturer's plant will be at the purchaser's expense. The purchaser will not accept any charges for visiting the plant. The manufacturer shall notify purchaser in writing of the intended date for shipment and test.

Relay settings will be provided to the Contractor by the Contracting Officer. Protective relays shall be thoroughly inspected, calibrated, and adjusted at the site in the presence of and at the discretion of the Contracting Officer.

The fiber optic cable and related equipment shall be tested. In addition to the end-to-end verification of operation of the fiber optic equipment, each fiber in the cable shall be tested for optical loss.

3.4 PRELIMINARY INSPECTION

Preliminary inspection of electrical equipment shall be conducted. Preliminary inspection, relay settings, and tests shall be as follows:

Equipment shall be inspected for damage or maladjustment caused by shipment or installation. Wedges, ties, blocks, and other packing material installed by manufacturer to prevent damage in shipment shall be removed.

Protective relays, auxiliary relays, trip coils, trip circuit seal-in and target coils, fuses, and instrument transformers shall be verified to be of the proper type and range.

Electrical continuity tests shall be performed on current, potential, and control circuits.

Ratio and polarity tests shall be performed on current and potential transformers.

Insulation tests shall be performed on relays, wiring, instrument-transformer secondary windings, and instruments.

Each adjustable relay shall be removed from its case and calibrated separately as an instrument, using a variable alternating-current source and an accurate timing device. This procedure shall verify that the relay has not been damaged in shipment and that it will perform in accordance with previously prepared time-current coordination curves at specified current tap and time dial settings.

With the relay disconnected and the main current transformer effectively open, a test current shall be applied to the remainder of the secondary

circuit to detect any open or short-circuit connections.

Relays shall then be reinstalled and connected into their current-transformer secondary and control circuits.

Any defects in electrical equipment, protective devices, wiring, or other conditions that will prevent complete coordination and the successful operation of equipment shall be reported to the Contracting Officer before proceeding with the work.

After the installation has been thoroughly tested and certified to be in satisfactory condition, with relays calibrated and adjusted to the proper current tap and time dial setting, the Contractor shall request permission to energize the equipment at system voltage for final testing.

3.5 ENERGIZING SWITCHGEAR ASSEMBLIES

Switchgear assembly shall not be energized until it is completely installed, tested, approved by the Contracting Officer, and ready for operation. Site testing shall have been conducted and approved by the Contracting Officer.

Using ammeter, voltmeter, and wattmeter or phase-angle meter, the values and polarities of voltage and current shall be measured and compared with those expected in the various relay circuits. Contact positions of directional elements and the voltage relays shall be inspected and noted.

After inspection and satisfactory tests have been completed on all active relay circuits under a no-load condition, each relay shall be given an operational test with diverted load currents or simulated ground faults.

A report shall be prepared with records of connections, settings, test values, operating performance, and failures or weaknesses found on test.

Tests and procedures for testing shall be in accordance with the manufacturer's recommendations, as approved by the Contracting Officer.

-- End of Section --

SECTION 33 77 19.00 40

MEDIUM-VOLTAGE GAS SWITCH
08/13

PART 1 GENERAL

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, and Section 26 05 70.00 40 HIGH VOLTAGE OVERCURRENT PROTECTIVE DEVICES and Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES apply to work specified in this section.

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment and Performance Data
Manufacturer's Catalog Data

SD-04 Drawings (Provide final drawings in AutoCad "DWG" or "DXF" electronic format)

Connection Diagrams
Elementary Diagrams
Fabrication/Erection/Installation Drawings
Outline Drawings
CT Performance and Saturation Curves

SD-09 Reports

Test Reports

SD-19 Operation and Maintenance Manuals

1.2 MAINTENANCE MATERIALS SUBMITTALS

Submit operation and maintenance manuals for switches, and space heaters.

PART 2 PRODUCTS

2.1 APPLICABLE STANDARDS

The design, fabrication, testing, and performance of circuit breakers shall conform with IEEE C37.06, IEEE C37.09, IEEE C37.010, IEEE C37.011, ASTM D2472, and as specified herein.

2.2 CIRCUIT BREAKERS, SF6 TYPE

Circuit breakers shall be the three-pole, 34.5 kV, 2000A continuous, 40 KA interrupting, outdoor type, and shall be single pressure SF6 type using puffer interrupters. Circuit breakers shall be delivered to the site

complete with all accessories ready for mounting, connection, and service.

Circuit breakers sahll be ABB type PM or approved equal.

2.3 SALIENT CHARACTERISTICS

1. Nominal voltage class, KV, RMS	34.5
2. Rated maximum votlage (L-L), KV< RMS	38
3. Impulse KV, Crest	200
4. Continuous current rating, 60 Hz, AMPS, RMS	2000
5. Maximum interrupting capability, KA, RMS, symmetrical	40
6. 3-Second short time current capability, KA,RMS	40
7. Close and latch capability, KA, RMS	64
8. Interrupting time in cycles	5
9. Auxiliary single-phase AC power supply to breaker in volts	208/120
10. Auxiliary DC power supply to breaker for closing/ tripping/alarms in volts	125
11. Interuppting medium	SF6 gas

2.4 COMPONENTS

2.4.1 Construction Details

Each circuit breaker shall be designed and constructed for operation on a 3-phase, 60 hertz, resistance grounded system with 34.5 kV between phases.

The circuit breakers shall be rated for operation from -30 degrees C to +40 degrees C at an altitude below 1000 meters.

The breakers shall operate with all three poles electrically and physically ganged for closing and tripping operations.

The operating mechanism and all auxiliary components shall be housed in one weatherproof, dust resistant enclosure mounted on the breaker frame.

the enclosures shall be painted on ANSI 70, light gray.

2.4.2 Operating Mechanism

The operating mechanism shall operate to open the three phases of the breaker simultaneously, and shall be electrically trip-free and mechanically or pneumatically trip-free, and shall include anti-pump provisions.

The tripping circuit mechanism and the closing control circuit mechanism shall each have a nominal voltage rating of 125 volts, dc. The tripping circuit shall operate satisfactorily for a tripping operation over a voltage range of 70-140 volts. The closing control circuit shall operate satisfactorily over a voltage range of 90-130 votls.

Two-pole knife swithces to isolate 125 VDC circuits and fuses shall be provided as indicated on the drawings for protecting control, close and tip circuits. Switches shall be capable of being pad-locked in the open position. During a tripping or trip-free operation, the tripping current shall not exceed 20 amperes.

The mechanism housing shall be provided with a removable plate in the bottom for conduit entrances. Heaters shall be provided with thermostatic control to maintain normal operation of the mechanism at ambient

temperatures ranging to minus 30 degrees F. Heaters shall be suitable for 208 volt ac oepration.

Tools shall be provided to permit opening and closing the breaker slowly for maintenance purposes.

The operating mechanism shall consist of one or more spring charged mechanisms. The operating mechanism shall include all auxiliary devices and accessories required.

Each operating mechanism shall include a mechanical position indicator which is directly coupled to the operating rod. The indicator shall be clearly visible without opening the operating mechanism enclosure.

Each operating mechanism shall store sufficient energy to allow one complete open-closed-open cycle with control power available.

2.4.3 Sub TitleOperating Controls

Low pressure alarm contacts shall be provided for all air, oil/nitrogen, and/or SF6 storage tanks. These contacts shall close at a pressure which still provides adequate means for one close-trip cycle operation. Low pressure cutout contacts shall be provided to prevent operation when pressurs fall below acceptable operating range.

2.4.4 Sub TitleBushings and Current Transformers

All bushings shall be rated in accordance with IEEE C57.19.01.

Bushings shall be constructed using epoxy weather sheds to provide high resistance to chipping and shattering.

Two 2000/5A multi-ratio current transformers shall be provided on each bushing as indicated on the drawings. The current transformers shall be relay accuracy class C800 with standard taps per IEEE C57.13.

All current transformer secondary leads shall be brought out through conduit to the mechanism housing and terminated on stud-type terminal blocks and with shorting bars.

2.4.5 Sub TitleAccessories

Auxiliary switches of the rotary type shall be furnished for 14 independent, single-poled control circuits. All contacts shall be wired to a terminal block, even if unused. Contacts, if not convertible, shall be provided with seven normally-open and seven normally-closed positions. Speed of switch shall correspond to that of breaker. Contacts shall be rated to break a minimum of 6 amps at 125 VDC.

The circuit breaker shall be furnished with latch checking switch, mechanical operation counter, thermal magnetic circuit breakers, fuses, motor starters, and thermal overload protection.

A counter shall be provided for indicating breaker operations.

Nameplates, diagrams, and documentation showing all ratings, ratios, and other pertinent data shall be provided.

The control cabinet shall include a 120V ac, 5ma, GFI-protected

convenience outlet. The cabinet shall be illuminated by a screw base heavy duty maintenance grade light actuated by a door switch.

All piping, conduit and wiring required for a complete breaker assembly shall be provided by the breaker manufacturer.

Two copper or copper-alloy grounding pads with NEMA 2-hole drilling shall be located on the base of the circuit breaker, one on each opposite corner.

One undervoltage relay shall be provided in the 125 VDC closing circuit as shown on the drawings to initiate a loss of DC alarm.

2.5 Sub TitleFACTORY TESTS

The manufacturer shall submit certified test data to demonstrate that factory tests have been performed, and that the breaker meets all requirements of this specification.

In addition to the tests above, the following certified test reports shall be furnished:

1. Operating speed test
2. Power factor and capacitance test of each bushing
3. Winding and lead resistance of each current transformer secondary
4. Excitation curve for current transformers
5. Ratio correction factor and phase angle curves

2.6 Sub TitleCIRCUIT BREAKERS, VACUUM TYPE

Power circuit breakers shall fully draw out with an electrically-controlled and store-energy-operated, three-pole, single-throw, removable element. The breakers shall be both electrically and mechanically trip-free in all positions of the closing sequence. The breaker operating mechanism shall have provisions for safe manual charging of the closing spring. The breaker mechanism shall be operable while the breaker is in the connected and test positions. The breaker shall be furnished with individual track rollers.

The circuit breakers shall use the vacuum interruption principle utilizing three independent vacuum bottles. Vacuum integrity shall be fully tested and certified prior to shpment of equipment.

The breaker compartment shall be furnished with a mechanism either electrically or manually oeprated to move the breaker between the operating, test, and disconnect positions. The mechanism shall be equipped with self-aligning and self-coupling primary and secondary disconnecting devices and will be rigidly held in the operating and test positions and in the disconnect position with the door closed. In the disconnect position, the breaker shall be easily removable from the compartment.

Means shall be provided for padlocking the breaker in either the connected (operating) position or the disconnected position. When locked in the disconnected position, the breaker shall be removable from the compartment. Padlocking shall not interfere with breaker operation.

No primary circuit components shall be exposed when the unit door is open. An automatc shutter shall cover the stationary primary disconnecting contacts when the breaker is in the disconnected and test position or out of the housing with full air clarance to live parts.

Primary disconnecting contacts shall be silver-plated.

The volrage for circuit breaker control and closing spring charging shall be 125V dc supplied from an external source.

Permissible control voltages shall be as follows:

Closing and auxiliary functions:	100 - 140 V dc
Tripping functions:	70 - 140 V dc

Circuit breakers of equal ratings shall be interchangeable.

Five normally open (N.O.) and five normally closed (N.C.) auxiliary contacts directly actuated by the circuit breaker mechanism shall be provided in addtion to any requirements of the switchgear manufacturer. These contacts shall be field convertible from N.O. to N.C. and vice verse. All auxiliary contacts shall be wired to terminal blocks.

Two N.O. and two N.C. auxiliary contacts directly actuated byt the physical location of the breaker shall be provided. The auxiliary switch shall be nmounted to the cubicle side wall and shall indicate if the breaker is in the connected position or has been retracted into the test/removed position. Contacts shall be wired to terminal blocks.

A mechanical operation counter shall be provided. Position indicators shall be provided to show whether the breaker is open or closed and in the connedcted, disconnected, and test positions.

Each circuit breaker shall be provided with a front-mounted close and trip device to operate the breaker in case of loss of control power.

Interlocks shall be provided on the circuit breaker as follows:

a. To prevent moving the movable element to or from the connected position when the circuit breaker is in the closed position.

b. To prevent closing the circuit breaker unless the primary disconnecting devices are in full contact of the circuit breaker is in the test position.

c. To prevent the complete withdrawal of the circuit breaker from the housing when the stored energy mechanism is charged.

d. To prevent the complete withdrawal of the circuit breaker until the closing function is blocked.

e. To automatically discharge the stored energy before withdrawing the circuit from the housing.

f. To prevent breakers of different ratings to be inserted into a compartment.

2.6.1 Sub TitleRelay and Control

All protective relays shall be installed on the front door of the switchgear units. Protective relays shall be mounted in dust-tight

semi-flush switchboard cases with removable front covers. All protective relays shall be designed to be completely removed from the relay case for inspection, repairs, and bench testing.

Unless specified otherwise, relays may be either electromechanical or solid state. Solid-state relays shall pass the SWC test in accordanc e with ANSI C37.90.1.

Westinghouse Type FT-1 test switches shall be provided to isolate all tripping functions. The current circuit of solid-state relays shall be provided with Westinghouse Type FT-1 shorting-type test switches.

Each tripping element of all protective relays shall have individual operation indicators which can be manually reset without removing the relay cover.

All relays shall be rated 5 amperes, 120 volts and shall be suitable for operation with 125V dc control voltage. All protective relays and relays used for control, regulation, monitoring, and auxiliary tripping shall designed and manufactured to meet all requirements of ANSI C37.90.

Manufacturer's types for each required relay function are identified on the drawings. The manufacturer shall not substitute other relays without written approval.

Unless otherwise specified, all auxiliary relays used for breaker control, and tripping shall have a minium contact rating of 10 amperes continuous. Auxiliary relay coils and contacts shall be directly wired to the relay studs.

Door-moutned relays shall be installed in semi-flush cases, all other relays shall be equipped with dust covers.

Auxiliary tripping relays shall have a maximum operating time of 16 mm at 125V dc.

All bus, tranformer, and breaker failure lock-out protection shall operate a rotary-type multi-contact, hand-reset auxiliary tripping relay equipped with mechanical target and oval operating handle. All N.O. contacts of these relays shall be wired to test switches (Westinghouse Type FT or equivalent).

Breaker control switches shall be electrically operated, have pistol grip handles and include indicators which will identify the last position to which the swithc was operated. All control switches shall be of the rotary spring return type. The contacts shall be silver and shall be enclosed with easily removable protective covers. The switch contacts shall be rated 20A continuous. Slip contacts "after trip" and "after close" shall be provided. Control switches shall be GE Type SBE or equivalent.

Three indicating lights shall be provided for each breaker to indicate the position of the breaker: The lamps shall be provided with a green-colored cap to indicate an open breaker; a red-colored cap to verify trip coil continuity and to indicate a closed breaker; and a white-colored cap to indicate a relay-initiated trip condition. The lamps shall be located above the associated breaker control switch.

An indicating light shall be provided with each hand-reset lock-out relay to verify the continuity of the relay coil. The lamp shall have an

amber-colored cap.

An alarm relay and indicating light shall be provided for each dc control circuit which is not monitored by a solid-state protection relay.

Long-life, low-voltage, low-energy LED lights shall be provided for all indicating lamps.

Blocking diodes used in control circuits shall have a minium PIV of 600V, a continuous rating of at least 1A, and a30 second rating of 30A.

2.6.2 Sub TitleMetering

Metering devices shall be provided as shwon on the drawings with programming software. Meters shall be factory programmed and calibrated.

Current and voltage test switches shall be provided to isolate and test all meters on each circuit breaker position. Suitable types include Westinghouse Type FT-1.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

The breakers shall be firmly mounted in place, and shall be leveled, shimmed, and anchored to the concrete using fasteners intended fo the purpose.

The manufacturer's guide for field installation shall be rigidly enforced.

If the circuite breakers will be stored longer than one month, the heaters shall be temporarily installed to protect the operating mechanism from moisture and corrosion.

Lifting of the circuit breakers shall be performed in strict accordance with the manufacturer's instructions.

The circuit breakers will be shipped pre-assembled, but the Conractor shall assembly extension legs, install top terminals of the bushings and fill the circuit breaker with SF6 gas as required to complete the assembly.

SF6 gas shall be added to the circuit breakers in strict accordance iwth the manufacturer's instructions.

3.2 FIELD TEST AND INSPECTIONS

The Contractor shall supply all personnel, equipment, and miscellaneous materials required to fully perform the tests as specified herein. Tests shall be performed by an independent testing company. The supervising test engineer shall have a miniumum of two years experience in high voltage testing. Test equipment shall have been calibrated within one year of field testing and shall bear the date of last calibration.

The Contractor shall be responsible for all tests and test reocrds for the work he has performed.

The Contractor shall notify the Contracting Officer of his/her intent to perform tests a minimum of 48 hours prior to the performance of the test.

The following visual inpsections shall be performed by the Contractor:

a. Inspect for physical damage, cracked insulators and gas leaks.

b. Compare equipement nameplae data with one-line diagram.

c. Verify operation of auxiliary devices.

d. Verify proper equipment grounding.

The following tests shall be performed by the Contractor:

The moisture content of the SF6 gas shall be measured with a Meeco Electrolytic Analyzer, Beckman Instrument Moisture Analyzer, or other device approved by the manufacturer of the circuit breaker. Teh maximum possible moisture shall be 200 ppm by volume.

An SF6 leak detector, approved by the circuit breaker manufacturer, shall be used to perform a leak test.

Using a 100 amepere minimum current, a ductor test shall be performed across the closed contacts of each circuit breaker pole. The maximum acceptable resistance shall be 200 micro-ohms.

A timing test shall be performed to determine the close/open characteristics of the circuit breaker. Minimum acceptable results shall be as specified by the manufacturer of the circuit breakers.

A 5,000 Vdc Megger test shall be performed between each bushing and ground with all bushings not under test grounded. The variance between readings shall not exceed 30%.

All current transformer wiring shall be checked for continuity and polarity.

Final test reports shall be submitted to the Contracting Officer for approval.

-- End of Section --