



WORK ORDER NO.

At the

PREPARED BY:

Architectural:
Civil:
Structural:

Mechanical:
Electrical:

Submitted By:

Date:

APPROVED BY:

Specifications:

For Commander, NAVFAC:
Date:

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LIST OF DRAWINGS
02/11

PART 1 GENERAL

1.1 SUMMARY

This section lists drawings associated with P712 Ship Berthing Power Upgrade project. The contractor must provide equipment indicated as "Government Furnished Contractor Installed Equipment".

1.2 CONTRACT DRAWINGS

Contract drawings are as follows:

DRAWING NO.	NAVFAC DWG NO.	TITLE
G-001	14043273	COVER SHEET
G-002	14043274	LIST OF SHEETS
B-001	14043275	TEST PIT LOCATION PLAN AND EARTHWORK NOTES
B-002	14043276	TEST PIT RESULTS
C-001	14043277	CIVIL NOTES AND LEGEND
C-101	14043278	EXISTING CONDITIONS
C-102	14043279	EROSION AND SEDIMENT CONTROL
C-103	14043280	DEMOLITION PLAN
C-104	14043281	CIVIL LAYOUT PLAN
C-105	14043282	GRADING PLAN
C-106	14043283	DUCT BANK PROFILE
C-501	14043284	CIVIL DETAILS
C-502	14043285	CIVIL DETAILS
S-001	14043286	STRUCTURAL NOTES
S-101	14043287	STRUCTURAL FOUNDATIONS
S-301	14043288	STRUCTURAL DETAILS
S-302	14043289	STRUCTURAL DETAILS
S-303	14043290	STRUCTURAL DETAILS
E-001	14043291	LEGEND, ABBREVIATIONS, AND GENERAL NOTES
E-002	14043292	ELECTRICAL SITE KEY PLAN
ED101	14043293	ELECTRICAL SITE DEMOLITION PLAN
ED401	14043294	ENLARGED ELECTRICAL SITE DEMOLITION PLAN - EXISTING
ED402	14043295	ENLARGED ELECTRICAL SITE DEMOLITION PLAN - BLDG. 1736
ED601	14043296	ELECTRICAL SYSTEM ONE-LINE DIAGRAM - 66KV-5.5KV
ED602	14043297	ELECTRICAL SYSTEM ONE-LINE DIAGRAM - 15KV DEMOLITION
ED701	14043298	BUILDING 1736 CONTROL FLOOR PLAN - DEMOLITION
ED702	14043299	BUILDING 64 POWER PLANT PARTIAL GROUND FLOOR PLAN - DEMOLITION
ED703	14043300	BLDG 64 POWER PLANT PARTIAL MEZZANINE FLOOR PLAN -
ES101	14043301	ELECTRICAL SITE PLAN

DRAWING NO.	NAVFAC DWG NO.	TITLE
ES102	14043302	ELECTRICAL SITE PLAN
ES103	14043303	ELECTRICAL SITE PLAN
ES104	14043304	ELECTRICAL SITE PLAN
ES401	14043305	ENLARGED ELECTRICAL SITE PLAN - 8kV/15kV SWITCHGEAR
ES402	14043306	ENLARGED ELECTRICAL SITE PLAN - SFC YARD
ES403	14043307	ENLARGED ELECTRICAL SITE PLAN - SFC YARD GROUNDING
ES404	14043308	ENLARGED ELECTRICAL SITE PLAN - SFC YARD AREA
ES405	14043309	ENLARGED ELECTRICAL SITE PLAN - EXISTING 15kV
ES406	14043310	ENLARGED ELECTRICAL SITE PLAN - SUBSTATION
ES407	14043311	ENLARGED ELECTRICAL SITE PLAN - SUBSTATION GROUNDING
ES501	14043312	66kV GAS-INSULATED SWITCHGEAR DETAILS
ES502	14043313	SEVIALLANA TRANSMISSION TERMINATION DETAILS
ES503	14043314	MANHOLE DETAILS
ES504	14043315	MANHOLE DETAILS - TYPE 5
ES505	14043316	MANHOLE DETAILS - TYPE 5 AND MV ENCLOSURE
ES506	14043317	LIGHTNING PROTECTION AND GROUNDING DETAILS
ES507	14043318	LIGHTNING PROTECTION, GROUNDING AND TRANSFORMER DETAILS
ES508	14043319	LIGHTING FIXTURE DETAILS
ES509	14043320	LIGHTING FIXTURE DETAILS
ES510	14043321	PHOTOCELL DETAILS
ES601	14043322	ELECTRICAL SYSTEM ONE-LINE DIAGRAM - 66KV-5.5KV
ES602	14043323	ELECTRICAL SYSTEM ONE-LINE DIAGRAM - 15KV POWER PLANT
ES603	14043324	ELECTRICAL SYSTEM ONE-LINE DIAGRAM - 15KV PIER #1
ES604	14043325	8kV SWITCHGEAR RISER DIAGRAM
ES605	14043326	15kV SWITCHGEAR RISER DIAGRAM
ES606	14043327	ELECTRICAL SYSTEM ONE-LINE DIAGRAM - 66kV GIS
ES607	14043328	66kV GIS TRANSFORMER AND FEEDER PROTECTION DIAGRAM
ES608	14043329	66kV GIS BUS PROTECTION AND LOCKOUT DIAGRAM
ES609	14043330	SUBSTATION CONTROL AND LIGHTING RISER DIAGRAM
ES610	14043331	CONDUIT AND CABLE SCHEDULE
ES611	14043332	CONDUIT AND CABLE SCHEDULE
ES612	14043333	CONDUIT AND CABLE, TRANSFORMER, AND LIGHTING FIXTURE
E-101	14043334	BUILDING 64 POWER PLANT PARTIAL GROUND FLOOR PLAN
E-102	14043335	BUILDING 64 POWER PLANT PARTIAL MEZZANINE FLOOR PLAN
E-601	14043336	BLDG. 64 600V ONE-LINE AND GROUNDING DIAGRAM
E-602	14043337	BLDG. 64 PANELBOARD SCHEDULE
E-701	14043338	8kV/15kV SWITCHGEAR HOUSE FLOOR PLAN
E-702	14043339	8kV/15KV SWITCHGEAR FRONT VIEW ELEVATIONS
E-703	14043340	8kV SWITCHGEAR TRANSFORMER AND FEEDER PROTECTION DIAGRAM
E-704	14043341	8KV SWITCHGEAR BUS PROTECTION AND LOCKOUT DIAGRAM
E-705	14043342	15kV SWITCHGEAR TRANSFORMER AND FEEDER PROTECTION
E-706	14043343	15kV SWITCHGEAR BUS PROTECTION AND LOCKOUT DIAGRAM
E-707	14043344	8kV/15kV SWITCHGEAR HOUSE NETWORK RISER DIAGRAM
E-708	14043345	8kV/15kV SWGH 600V ONE-LINE RISER AND GROUNDING DIAGRAM
E-709	14043346	8kV/15kV SWITCHGEAR HOUSE PANELBOARD SCHEDULE

DRAWING NO.	NAVFAC DWG NO.	TITLE
E-710	14043347	8kV/15kV SWITCHGEAR HOUSE PANELBOARD SCHEDULE
E-801	14043348	SUS #1 - DETAILS
E-802	14043349	SUS #1 - ONE-LINE DIAGRAM
E-803	14043350	SUS #1 - CONTROL DIAGRAMS
E-804	14043351	SPIS - DETAILS
E-805	14043352	SPIS - ONE-LINE DIAGRAM
E-901	14043353	SFC HOUSE FLOOR PLAN
E-902	14043354	SFC ONE-LINE DIAGRAM AND FRONT VIEW ELEVATIONS
E-903	14043355	SFC HOUSE 600V ONE-LINE AND GROUNDING DIAGRAM
E-904	14043356	SFC HOUSE PANELBOARD SCHEDULES

-- End of Document --

SECTION 01 33 00

SUBMITTAL PROCEDURES

05/11

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Submittal Descriptions (SD)

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

SD-01 Preconstruction Submittals

Submittals which are required prior to or commencing work on site.

Certificates of insurance

Surety bonds

List of proposed Subcontractors

List of proposed products

Construction progress schedule

Network Analysis Schedule (NAS)

Submittal register

Schedule of prices

Health and safety plan

Work plan

Quality Control(QC) plan

Environmental protection plan

SD-02 Shop Drawings

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

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

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

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts,

instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

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

SD-05 Design Data

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

SD-06 Test Reports

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

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

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

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

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

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

Confined space entry permits.

Text of posted operating instructions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be

signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

SD-10 Operation and Maintenance Data

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

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

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

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

1.1.2 Approving Authority

Office or designated person authorized to approve submittal.

1.1.3 Work

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

1.2 SUBMITTALS

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

SD-01 Preconstruction Submittals

Submittal Register; G

1.3 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.4 FORWARDING SUBMITTALS REQUIRING GOVERNMENT APPROVAL

1.4.1 Submittals Required from the Contractor

As soon as practicable after award of contract, and before procurement of fabrication, forward to the Commander, NAVFAC Atlantic, Code CI4A1, 6506 Hampton Boulevard, Norfolk, Virginia, 23508-1278 submittals required in the technical sections of this specification, including shop drawings, product data and samples. One copy of the transmittal form for all submittals must be forwarded to the Resident Officer in Charge of Construction.

NAVFAC Atlantic will review and approve for the Contracting Officer those submittals reserved for Contracting Officer approval to verify submittals comply with the contract requirements.

1.4.1.1 O&M Data

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

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

1.4.1.2 Overseas Shop Drawing Submittals

All submittals must be sent via overnight express mail service. All costs associated with the overnight express mail service must be borne by the construction Contractor. Costs associated with the overnight express mail of submittals related to proposed submittal variances of resubmittals necessary as a result of noncompliant or incomplete Contractor submittals must be the responsibility of the Contractor.

1.5 PREPARATION

1.5.1 Transmittal Form

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

1.5.2 Identifying Submittals

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

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

- a. Project title and location.
- b. Construction contract number.
- c. Date of the drawings and revisions.
- d. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other subcontractor associated with the submittal.
- e. Section number of the specification section by which submittal is required.
- f. Submittal description (SD) number of each component of submittal.
- g. When a resubmission, add alphabetic suffix on submittal description, for example, submittal 18 would become 18A, to indicate resubmission.
- h. Product identification and location in project.

1.5.3 Format for SD-02 Shop Drawings

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

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

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

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

Reserve a blank space, no smaller than 50 x 100 inches on the right hand side of each sheet for the Government disposition stamp.

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

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

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

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

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

pertains.

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

Include the manufacturer's name, trade name, place of manufacture, and catalog model or number on product data. Also include applicable federal, military, industry and technical society publication references. Should manufacturer's data require supplemental information for clarification, submit as specified for SD-07 Certificates.

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

Collect required data submittals for each specific material, product, unit of work, or system into a single submittal and marked for choices, options, and portions applicable to the submittal. Mark each copy of the product data identically. Partial submittals will not be accepted for expedition of construction effort.

Submit manufacturer's instructions prior to installation.

1.5.5 Format of SD-04 Samples

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

- a. Sample of Equipment or Device: Full size.
- b. Sample of Materials Less Than 2 by 3 inches: Built up to 8 1/2 by 11 inches.
- c. Sample of Materials Exceeding 8 1/2 by 11 inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.
- d. Sample of Linear Devices or Materials: 10 inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.
- e. Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.
- f. Color Selection Samples: 2 by 4 inches. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes

and quantities of samples are to represent their respective standard unit.

- g. Sample Panel: 4 by 4 feet.
- h. Sample Installation: 100 square feet.

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

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

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

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

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

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

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

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

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

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

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

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

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

1.6 QUANTITY OF SUBMITTALS

1.6.1 Number of Copies of SD-02 Shop Drawings

Submit six copies of submittals of shop drawings requiring review and approval only by QC organization and seven copies of shop drawings requiring review and approval by Contracting Officer.

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

Submit in compliance with quantity requirements specified for shop drawings.

1.6.3 Number of Samples SD-04 Samples

- a. Submit one samples, or one sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by approving authority and one will be returned to Contractor.
- b. Submit one sample panel or provide one sample installation where directed. Include components listed in technical section or as directed.
- c. Submit one sample installation, where directed.
- d. Submit one sample of non-solid materials.

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

Submit in compliance with quantity requirements specified for shop drawings.

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

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

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

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

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

Unless otherwise specified, submit two sets of administrative submittals.

1.7 VARIATIONS

Variations from contract requirements require both Designer of Record (DOR) and Government approval pursuant to contract Clause FAR 52.236-21 and will be considered where advantageous to Government.

1.7.1 Considering Variations

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

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

1.7.2 Proposing Variations

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

1.7.3 Warranting That Variations Are Compatible

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

1.7.4 Review Schedule Is Modified

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

1.8 SUBMITTAL REGISTER

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

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

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

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

Column (f): Indicate approving authority for each submittal.

1.8.1 Use of Submittal Register

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

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

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

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

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

1.8.2 Contractor Use of Submittal Register

Update the following fields in the Government-furnished submittal register program or equivalent fields in program utilized by Contractor with each submittal throughout contract.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (j) Action Code (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l) List date of submittal transmission.

Column (q) List date approval received.

1.8.3 Approving Authority Use of Submittal Register

Update the following fields in the Government-furnished submittal register program or equivalent fields in program utilized by Contractor.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (l) List date of submittal receipt.

Column (m) through (p) List Date related to review actions.

Column (q) List date returned to Contractor.

1.8.4 Action Codes

Entries for columns (j) and (o), are to be used are as follows (others may be prescribed by Transmittal Form):

1.8.4.1 Government Review Action Codes

"A" - "Approved as submitted"; "Completed"

"B" - "Approved, except as noted on drawings"; "Completed"

"C" - "Approved, resubmission required"; "Resubmit"

"D" - "Returned by correspondence"; "Completed"

"E" - "Disapproved (See attached)"; "Resubmit"

"F" - "Receipt acknowledged"; "Completed"

"G" - "Other (Specify)"; "Resubmit"

"X" - "Receipt acknowledged, does not comply"; "Resubmit"

1.8.5 Copies Delivered to the Government

Deliver one copy of submittal register updated by Contractor to Government with each invoice request.

1.9 SCHEDULING

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals. An additional 14 calendar days will be allowed and shown on the register for review and approval of submittals for substation, power transformers, static frequency converters, switchgear, switchgear house, secondary unit substation, shore power industrial stations, and associated controls for each item.

- a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements.
- b. Submittals called for by the contract documents will be listed on the register. If a submittal is called for but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the register or marked "N/A."
- c. Re-submit register and annotate monthly by the Contractor with actual submission and approval dates. When all items on the register have been fully approved, no further re-submittal is required.
- d. Carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."
- e. Except as specified otherwise, allow review period, beginning with receipt by approving authority, that includes at least 15 working days for submittals for QC Manager approval and 20 working days for submittals for Contracting Officer approval. Period of review for submittals with Contracting Officer approval begins when Government receives submittal from QC organization.
- f. For submittals requiring review by fire protection engineer, allow review period, beginning when Government receives submittal from QC organization, of 30 working days for return of submittal to the Contractor.
- g. Period of review for each resubmittal is the same as for initial submittal.

1.9.1 Reviewing, Certifying, Approving Authority

The QC organization is responsible for reviewing and certifying that submittals are in compliance with contract requirements. Approving authority on submittals is QC Manager unless otherwise specified for specific submittal. At each "Submittal" paragraph in individual specification sections, a notation "G," following a submittal item,

indicates Contracting Officer is approving authority for that submittal item.

1.9.2 Constraints

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

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

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

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

1.9.3 QC Organization Responsibilities

- a. Note date on which submittal was received from Contractor on each submittal.
- b. Review each submittal; and check and coordinate each submittal with requirements of work and contract documents.
- c. Review submittals for conformance with project design concepts and compliance with contract documents.
- d. Act on submittals, determining appropriate action based on QC organization's review of submittal.
 - (1) When QC Manager is approving authority, take appropriate action on submittal from the possible actions defined in paragraph entitled, "Approved/Accepted Submittals," of the section."
 - (2) When Contracting Officer is approving authority or when variation has been proposed, forward submittal to Government with certifying statement or return submittal marked "not reviewed" or "revise and resubmit" as appropriate. The QC organization's review of submittal determines appropriate action.
- e. Ensure that material is clearly legible.
- f. Stamp each sheet of each submittal with QC certifying statement or approving statement, except that data submitted in bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.
 - (1) When approving authority is Contracting Officer, QC organization will certify submittals forwarded to Contracting Officer with the following certifying statement:

"I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract Number TBD, is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is submitted for Government approval.

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Certified by QC Manager _____, Date _____"
(Signature)

(2) When approving authority is QC Manager, QC Manager will use the following approval statement when returning submittals to Contractor as "Approved" or "Approved as Noted."

"I hereby certify that the (material) (equipment) (article) shown and marked in this submittal and proposed to be incorporated with contract Number TBD, is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is approved for use.

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Approved by QC Manager _____, Date _____"
(Signature)

- g. Sign certifying statement or approval statement. The QC organization member designated in the approved QC plan is the person signing certifying statements. The use of original ink for signatures is required. Stamped signatures are not acceptable.
- h. Update submittal register database as submittal actions occur and maintain the submittal register at project site until final acceptance of all work by Contracting Officer.
- i. Retain a copy of approved submittals at project site, including Contractor's copy of approved samples.

1.10 GOVERNMENT APPROVING AUTHORITY

When approving authority is Contracting Officer, the Government will:

- a. Note date on which submittal was received from QC Manager.
- b. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.
- c. Identify returned submittals with one of the actions defined in paragraph entitled, "Review Notations," of this section and with markings appropriate for action indicated.

Upon completion of review of submittals requiring Government approval, stamp and date approved submittals. Two copies of the approved submittal will be retained by the Contracting Officer and two copies of the submittal will be returned to the Contractor.

1.10.1 Review Notations

Contracting Officer review will be completed within 14 calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

- a. Submittals marked "approved" or "accepted" authorize the Contractor to proceed with the work covered.
- b. Submittals marked "approved as noted" "or approved except as noted, resubmittal not required," authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.
- c. Submittals marked "not approved" or "disapproved," or "revise and resubmit," indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work must proceed for this item until resubmittal is approved.
- d. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

1.11 DISAPPROVED OR REJECTED SUBMITTALS

Contractor must 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," is to be given to the Contracting Officer. Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

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

1.12 APPROVED/ACCEPTED SUBMITTALS

The Contracting Officer's approval or acceptance of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing and other information are satisfactory.

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

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

1.13 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract

requirements. Before submitting samples, the Contractor to assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

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

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

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

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

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
P712 GFE

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS	
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE			DATE OF ACTION
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 33 00	SD-01 Preconstruction Submittals														
			Submittal Register	1.8	G												
		26 05 33	SD-02 Shop Drawings														
			600 V Shore Power Industrial Station	2.1	G												
			SD-03 Product Data														
			600 V Single Pole Connectors	2.1.2	G												
			Circuit Breaker	2.1.3	G												
			Control Power Transformer	2.1.5	G												
			Shunt Trip and Close	2.1.4	G												
			Pushbuttons														
			Flexible Cable	2.1.8	G												
			Power Distribution Block	2.1.7	G												
			SD-06 Test Reports														
			Paint Coating System	2.5.1	G												
			600 V Single Pole Connector	2.5.2	G												
			Compatibility Tests														
			600 V Single Pole Connector	2.5.3	G												
			Torque Test														
			SD-10 Operation and Maintenance Data														
			600 V Shore Power Industrial Station	2.1	G												
			SD-11 Closeout Submittals														
			Equipment Test Schedule	2.5.4	G												
			Equipment Inspection Schedule	2.5.5	G												

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT OR CLASSIFICATION REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY				REMARKS		
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE		DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 11 16	SD-02 Shop Drawings														
			Secondary Unit Substation Drawings	1.5.1.1	G												
			Transformer Drawings	1.5.1.2	G												
			SD-03 Product Data														
			Secondary Unit Substation	2.1	G												
			Transformer	2.1.2	G												
			Switchgear	2.1.4	G												
			SD-07 Certificates														
			Paint Coating System	1.5.2	G												
			Transformer Efficiencies	2.1.2.3	G												
			SD-09 Manufacturer's Field Reports														
			Switchgear Design Tests	2.5.3	G												
			Switchgear Production Tests	2.5.4	G												
			Transformer Design Tests	2.5.5	G												
			Transformer Acceptance Tests	2.5.6	G												
			Transformer Routine and Other Tests	2.5.7	G												
			SD-10 Operation and Maintenance Data														
			Secondary Unit Substation O & M	1.6.1	G												
			SD-11 Closeout Submittals														
			Local O & M Manuals	1.6.2	G												
			Equipment Test Schedule	2.5.1	G												
			Equipment Inspection Schedule	2.5.2	G												

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY				REMARKS		
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE		DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH
		26 12 19.10	SD-02 Shop Drawings														
			Pad-Mounted Transformer Drawings	1.5.1	G												
			SD-03 Product Data														
			Pad-Mounted Transformers	2.2	G												
			SD-07 Certificates														
			Transformer Efficiencies	2.2.2.1	G												
			SD-09 Manufacturer's Field Reports														
			Design Tests	2.6.2	G												
			Routine and Other Tests	2.6.3	G												
			SD-10 Operation and Maintenance Data														
			Transformer(s)	1.6.1	G												
			SD-11 Closeout Submittals														
			Transformer Test Schedule	2.6.1	G												
		26 13 00	SD-02 Shop Drawings														
			Switchgear Drawings	1.5.1	G												
			SD-03 Product Data														
			Electronic Overcurrent Control Curves	1.5.3	G												
			SF6/High-Firepoint Fluid Insulated Pad-Mounted Switchgear	1.6.1	G												

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT OR CLASSIFICATION REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					REMARKS	
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		MAILED TO CONTR/ DATE RCD FRM APPR AUTH
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 13 00	SF6/High-Firepoint Fluid Insulated Pad-Mounted Switchgear	2.1	G												
			Insulated High-Voltage Connectors	2.2	G												
			Surge Arresters	2.3	G												
			SD-07 Certificates														
			Paint Coating System	1.5.2	G												
			SD-09 Manufacturer's Field Reports														
			Switchgear Design and Production Tests	2.4.1	G												
			SD-10 Operation and Maintenance Data														
			SF6/High-Firepoint Fluid Insulated Pad-Mounted Switchgear	1.6.1	G												
			SF6/High-Firepoint Fluid Insulated Pad-Mounted Switchgear	2.1	G												
		26 13 13	SD-02 Shop Drawings														
			Metal-Clad Switchgear Drawings	1.4.1	G												
			SD-03 Product Data														
			Metal-Clad Switchgear	2.1	G												
			Protection Relays	2.2	G												
			SCADA Devices	2.3	G												

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CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT OR CLASSIFICATION REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY				REMARKS		
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE		DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 13 13	SD-05 Design Data														
			Structural Design Report	2.1.2	G												
			SD-07 Certificates														
			Paint Coating System	2.8.4	G												
			SD-09 Manufacturer's Field Reports														
			Switchgear Design Tests	2.8.2	G												
			Switchgear Production Tests	2.8.3	G												
			SD-10 Operation and Maintenance Data														
			Metal-Clad Switchgear O & M	1.5.1	G												
			SD-11 Closeout Submittals														
			Formal Request For Settings	1.4.2	G												
			Local O & M Manuals	1.5.2	G												
			Equipment Test Schedule	2.8.1	G												
		26 13 14	SD-02 Shop Drawings														
			Switchgear House Drawings	1.4.1	G												
			SD-03 Product Data														
			Switchgear House	2.1	G												
			SD-07 Certificates														
			Paint Coating System	1.4.2	G												
			SD-10 Operation and Maintenance Data														
			Switchgear House O & M	1.5.1	G												
			SD-11 Closeout Submittals														
			Local O & M Manuals	1.5.2	G												

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CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVTOR CLASSIFICATION REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					REMARKS		
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		MAILED TO CONTR/ DATE RCD FRM APPR AUTH	
																		(g)
		26 13 14	Equipment Test Schedule	2.2.1	G													
			Equipment Inspection Schedule	2.2.2	G													
		26 20 00	SD-02 Shop Drawings															
			Panelboards	2.12.2.1	G													
			SD-03 Product Data															
			Receptacles	2.11	G													
			Circuit Breakers	2.12.2.1.3	G													
			Switches	2.9	G													
			Lighting Contactor	2.12.2.3	G													
			Automatic Transfer Switch	2.12.2.2	G													
			Battery System	2.13	G													
			Surge Protective Devices	2.19	G													
			SD-05 Design Data															
			Battery Power Calculations	1.5.2	G													
			SD-06 Test Reports															
			600-Volt Wiring Test	3.5.2	G													
			Grounding System Test	3.5.4	G													
			Ground-Fault Receptacle Test	3.5.3	G													
			SD-07 Certificates															
			Fuses	2.10	G													
		26 27 14.00 20	SD-02 Shop Drawings															
			Installation Drawings	1.5.1	G													
			SD-03 Product Data															
			Electricity Meters	2.1.2	G													
			SD-10 Operation and Maintenance Data															

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

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.

ASTM INTERNATIONAL (ASTM)

ASTM E1971 (2005; R 2011) Stewardship for the Cleaning of Commercial and Institutional Buildings

1.2 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The subcontractors must compile and prepare data and deliver to the Contractor prior to the training of Government personnel. The Contractor must compile and prepare aggregate O&M data including clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

1.2.1 Package Quality

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

1.2.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission.

1.2.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data must be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Submit changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data within 30 calendar days of the notification of this change requirement.

1.2.4 O&M Database

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

1.3 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.3.1 Operating Instructions

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

1.3.1.1 Safety Precautions

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

1.3.1.2 Operator Prestart

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

1.3.1.3 Startup, Shutdown, and Post-Shutdown Procedures

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

1.3.1.4 Normal Operations

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

1.3.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.3.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.3.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.3.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance

to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.3.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

- a. A table showing recommended lubricants for specific temperature ranges and applications.
- b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.
- c. A Lubrication Schedule showing service interval frequency.

1.3.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.3.2.3 Cleaning Recommendations

Provide environmentally preferable cleaning recommendations in accordance with ASTM E1971.

1.3.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.3.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.3.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.3.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.3.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.3.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.3.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.3.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.3.5.1 Product Submittal Data

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

1.3.5.2 Manufacturer's Instructions

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

1.3.5.3 O&M Submittal Data

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

1.3.5.4 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations

and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog

1.3.5.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.3.5.6 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.3.5.7 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.3.5.8 Testing and Performance Data

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

1.3.5.9 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.4 TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES

Include Data Package 5 and the following for control systems:

- a. Narrative description on how to perform and apply all functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.
- b. Full as-built sequence of operations.
- c. Copies of all checkout tests and calibrations performed by the Contractor.

- c. Full as-built print out of software program.
- d. Electronic File:
 - (1) Assemble each manual into a composite electronically indexed file in PDF format. Provide HDD's, DVD's or CD's as appropriate, so that each one contains all maintenance and record files, and also the Project Record Documents and Training Videos, of the entire program for this facility.
 - (2) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - (3) Link the index to separate files within the composite of files. Book mark maintenance and record files, that have a Table of Contents, according to the Table of Contents

1.5 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

1.5.1 Data Package 5

- a. Safety precautions
- b. Operator prestart
- c. Start-up, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Environmental conditions
- f. Preventive maintenance plan and schedule
- g. Troubleshooting guides and diagnostic techniques
- h. Wiring and control diagrams
- i. Maintenance and repair procedures
- j. Removal and replacement instructions
- k. Spare parts and supply list
- l. Product submittal data
- m. Manufacturer's instructions
- n. O&M submittal data
- o. Parts identification
- p. Testing equipment and special tool information

- q. Warranty information
- r. Testing and performance data
- s. Contractor information

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS

07/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D709 (2013) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

IEEE C2 (2012; Errata 2012; INT 1-4 2012; INT 5-7 2013) National Electrical Safety Code

IEEE C57.12.28 (2014) Standard for Pad-Mounted Equipment - Enclosure Integrity

IEEE C57.12.29 (2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3 2014) National Electrical Code

1.2 RELATED REQUIREMENTS

This specification applies to all sections of Division 26 ELECTRICAL of this project unless otherwise specified in the individual sections. This specification has been incorporated into, and thus, does not apply to and is not referenced in the following sections:

Section 26 05 33 DOCKSIDE POWER CONNECTION STATIONS
 Section 26 11 16 SECONDARY UNIT SUBSTATIONS
 Section 26 12 19.10 THREE-PHASE PAD MOUNTED TRANSFORMERS
 Section 26 13 00 SF6/HIGH-FIREPOINT FLUIDS INSULATED PAD-MOUNTED SWITCHGEAR
 Section 26 13 13 METAL-CLAD SWITCHGEAR
 Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM
 Section 26 27 14.00 20 ELECTRICITY METERING

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, must be as defined in IEEE 100.
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

This project will consist of the procurement of, but not limited to, an electrical equipment house, metal clad switchgears, secondary unit substations, industrial shore power stations, pad mounted transformers, pad mounted SF6/High-Firepoint fluid switchgear, and electricity meters. The electrical characteristics will consists of, but not limited to, the following electrical systems:

- a. 12,470 volt, three phase, three wire, 60Hz.
- b. 5,500 volt, three phase, three wire, 50Hz.
- c. 480Y/277V, three phase, four wire, 60Hz.
- d. 480Y/277V, three phase, three wire, 60Hz.
- e. 400Y/230V, three phase, three wire, 50Hz.

Final terminations must be provided by construction contractor, as directed by the Contracting Officer.

1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.5.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams must identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings must indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.2 Product Data (SD-03)

Submittal must include performance and characteristic curves.

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site must not be used, unless specified otherwise.

1.7 WARRANTY

The equipment items must be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions must 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 must not fade when exposed to sunlight and must be secured to prevent easy removal or peeling.

1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment must have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription must identify the function and, when applicable, the position. Nameplates must be melamine plastic, **0.125 inch** thick, white with black center core. Surface must be matte finish. Corners must be square. Accurately align lettering and engrave into the core. Minimum size of nameplates must be **one by 2.5 inches**. Lettering must be a minimum of **0.25 inch** high normal block style.

1.11 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

- a. When the enclosure integrity of such equipment is specified to be in accordance with **IEEE C57.12.28** or **IEEE C57.12.29**, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign must be a decal and must 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" must be in white letters on a red background and the words "HIGH VOLTAGE" must be in black letters on a white background. Decal must be Panduit No. PPS0710D72 or approved equal.

1.12 ELECTRICAL REQUIREMENTS

Electrical installations must conform to **IEEE C2**, **NFPA 70**, and requirements specified herein.

1.13 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified

systems and equipment, including pertinent safety requirements as required. Instructors must be thoroughly familiar with all parts of the installation and must be trained in operating theory as well as practical operation and maintenance work. Instruction must be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished must be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment must have factory-applied painting systems which must, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements specified in the technical sections.

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting must be as specified in the section specifying the associated electrical equipment.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

-- End of Section --

SECTION 26 05 33

DOCKSIDE POWER CONNECTION STATIONS

01/07

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M	(2014) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM B3	(2013) Standard Specification for Soft or Annealed Copper Wire
ASTM B8	(2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D1535	(2013) Specifying Color by the Munsell System
ASTM D2240	(2005; R 2010) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D709	(2013) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013) National Electrical Safety Code
IEEE C37.13	(2008; INT 1 2009; AMD 1 2012) Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C57.12.29	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ST 20	(1992; R 1997) Standard for Dry-Type Transformers for General Applications
NEMA Z535.4	(2011) American National Standard for Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3 2014) National Electrical Code
- NFPA 70E (2012; Errata 2012) Standard for Electrical Safety in the Workplace

UNDERWRITERS LABORATORIES (UL)

- UL 44 (2014; Reprint Jun 2014) Thermoset-Insulated Wires and Cables
- UL 50 (2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations
- UL 94 (2013) Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS apply to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, must be as defined in IEEE 100.

1.4 SUBMITTALS

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

SD-02 Shop Drawings

600 V Shore Power Industrial Station; G

SD-03 Product Data

600 V Single Pole Connectors; G

Circuit Breaker; G

Control Power Transformer; G

Shunt Trip and Close Pushbuttons; G

Flexible Cable; G

Power Distribution Block; G

SD-06 Test Reports

Paint Coating System; G

600 V Single Pole Connector Compatibility Tests; G

600 V Single Pole Connector Torque Test; G

SD-10 Operation and Maintenance Data

600 V Shore Power Industrial Station, data package 5; G

SD-11 Closeout Submittals

Equipment Test Schedule; G

Equipment Inspection Schedule; G

1.5 QUALITY ASSURANCE

1.5.1 Drawings

Furnish drawings that include, but are not limited to, the following:

- a. One-line diagram including breakers, fuses, current transformers, and meters.
- b. Outline drawings including front elevation, section views, footprint, and overall dimensions.
- c. Markings and NEMA nameplate data, including fuse information (manufacturer's name, catalog number, and ratings).
- d. Circuit breaker type, interrupting rating, and trip devices, including available settings.
- e. Three-line diagrams and elementary diagrams and wiring diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.
- f. Manufacturer's instruction manuals and published time-current curves (on full size logarithmic paper) of the main secondary breaker and largest secondary feeder device. These must be used by the designer of record to provide breaker settings that will insure protection and coordination are achieved.

1.5.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of [NFPA 70](#) and [IEEE C2](#) unless more stringent requirements are specified or indicated.

1.5.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer and the component parts of the item must be the products of the same manufacturer.

1.5.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site must not be used, unless specified otherwise.

1.6 WARRANTY

The equipment items must be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7 MAINTENANCE

1.7.1 Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 600 V SHORE POWER INDUSTRIAL STATION

Shore power industrial station assemblies must include enclosure, power receptacles, auxiliary devices, and related wiring. Each shore power industrial station must have the number of circuits indicated and each circuit must provide three-phase, three-wire service. Shore power industrial station must be totally complete, tested, and ready for operation prior to shipment and after installation at the site.

2.1.1 Enclosure Integrity

Provide an UL 50 listed, NEMA Type 3R, fabricated entirely of ASTM A240/A240M type 304 or 304L stainless steel enclosure. All interior and exterior panels and doors must be minimum 12 gauge stainless steel sheets. Each unit must have a fixed top and open bottom, gasketed bolt-on and removable access panels, and hinged rear lockable door with 90 degree stop. Ventilating or similar openings in equipment must be designed so

that foreign objects inserted through these openings are deflected from energized parts. Paint enclosure [ASTM D1535](#) light grey No. 61. Paint coating system must comply with [IEEE C57.12.29](#).

2.1.1.2 600 V Single Pole Connectors

Provide insulated connectors rated for 600 volts, 690 amperes, 60 hertz, single pole, continuous duty operation. Connectors must be compatible with Leviton and Duraline cam-type positive latching ball nose connectors. Insulation and protective caps must be ethylene propylene thermoplastic rubber (EPTR) colored black phase A, white phase B, and red phase C, conforming to the following:

- a. Constant Service Temperature Range: [minus 81 degrees F to 275 degrees F](#)
- b. Flammability: [UL 94](#) HB Rated
- c. Electrical: UL Relative Thermal Index (RTI): [212 degrees F](#) minimum
- d. Durometer Hardness: [ASTM D2240](#), 55 - 65A

2.1.1.2.1 Panel Mount Connectors

Provide 15 degree angled, panel mount female connectors (receptacles) with threaded stud terminations. Each receptacle must be provided with a protective cap attached via wirelon.

2.1.1.2.2 Cable Mount In-Line Connectors

Provide male cable mount in-line connectors (plugs) designed for terminating on 500 kcmil cables with a crimp-type connection. The connectors must lock together so that they can not twist or turn loose unless a push button release mechanism is engaged. The insulated sleeve must be mechanically secured to the connector contacts to give a minimum of [700 pounds](#) shear force.

2.1.1.3 Circuit Breaker

[IEEE C37.13](#). 120 VAC electrically operated stationary, unfused, small-frame, low-voltage power circuit breaker with a short-circuit current rating of 42,000 rms amperes symmetrical at 508 volts. Breaker frame size must be 800 amperes.

2.1.1.3.1 2.1.3.1 Electronic Trip Units

Equip breakers with a solid-state tripping system consisting of three current sensors and a microprocessor-based trip unit that will provide true rms sensing adjustable time-current circuit protection. The ampere rating of the current sensors are to be 600 amperes. The trip unit ampere rating must be 600 amperes.

- a. Breakers must have long delay pick-up and time settings, short delay pick-up and time settings, instantaneous settings, current imbalance, and LED indication of cause of circuit breaker trip.
- b. Breakers must have a digital display for phase voltage from sensors connected to the line side. The trip unit must not any connections to the load side.

2.1.4 Shunt Trip and Close Pushbuttons

Provide NEMA Q600 rated, 30 millimeter, heavy duty industrial type, normally-open, momentary, illuminated LED flush pushbuttons colored red and green behind a lockable clear cover.

2.1.5 Control Power Transformer

NEMA ST 20, general purpose, dry-type, self-cooled, resin encapsulated, nonventilated. Transformer must have 180 degrees C insulation with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformer of 115 degrees C temperature rise must be capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.

2.1.6 Heater

Provide 250 watts minimum 120-volt stainless steel heaters. Heaters must be of sufficient capacity to control moisture condensation in the compartments.

2.1.7 Power Distribution Block

Provide an UL recognized, four pole, 600 volt, 500 amperes minimum, power distribution block to terminate feeder incoming and outgoing wiring as indicated. The power distribution block must be capable of terminating copper wiring and have a short circuit current rating, at a minimum, equivalent to the circuit breaker. Provide each power distribution block with a clear plastic cover.

2.1.8 Flexible Cable

UL 44. Provide an annealed copper, Diesel Locomotive Cable (DLO), rated at 2000 volt, type RHH or RHW-2. DLO cable must comply with ASTM B3 and ASTM B8. Size DLO cable as indicated. For the exception of control wiring, multiconductor cables are not acceptable.

2.1.9 Enclosure Configurations

Provide shore power industrial station as indicated. All receptacles of the same circuit must be mounted on a common side cover plate. Provide cable slack for removal of receptacles without disconnecting the power cable. Provide an internal and external full width ground bus. Mount low-voltage circuit breakers, power distribution blocks, control power transformer, and heaters on the inside of the enclosure. Provide overcurrent protection of auxillary equipment.

2.2 MANUFACTURER'S NAMEPLATE

Each item of equipment must have a nameplate bearing the manufacturer's name, address, model number, phone number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.3 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription must identify the function and, when applicable, the position. Nameplates must be melamine plastic, 0.125 inch

thick, white with black center core. Surface must be matte finish. Corners must be square. Accurately align lettering and engrave into the core. Minimum size of nameplates must be **one by 2.5 inches**. Lettering must be a minimum of **0.25 inch** high normal block style.

2.4 WARNING SIGNS

Provide warning signs for flash protection in accordance with **NFPA 70E** and **NEMA Z535.4** for industrial control panels that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized. Provide field installed signs to warn qualified persons of potential electric arc flash hazards when warning signs are not provided by the manufacturer. Provide marking that is clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.5 SOURCE QUALITY CONTROL

2.5.1 Paint Coating System

Submit **IEEE C57.12.29** paint coating system performance requirement tests.

2.5.2 600 V Single Pole Connector Compatibility Tests

Conduct the following tests in the sequence noted on a male in-line connector mated with a Leviton or Duraline female in-line connector with each connector terminated on a bare 500 kcmil copper conductor. After completion of the tests, inspect assemblies. There must be no evidence of damage to the connectors. Assemblies must be satisfactory for immediate return to service at full ratings without maintenance or repair. A factory-certified report of the specified tests previously performed on identical units of each rating will be acceptable.

2.5.2.1 Impact Test

Drop each mated connector set in a horizontal position from a height of 36-inches onto a concrete floor 50 times.

2.5.2.2 Pull Strain Test

Apply a 500-lb straight pull on each mated connector set for a duration of 5-minutes.

2.5.2.3 Shear Test

Apply a 100-lb perpendicular pull on each mated connector set for a duration of 5-minutes.

2.5.2.4 Torque Test

Apply a 100 ft-lb torque on each mated connector set for a duration of 5-minutes.

2.5.2.5 Heat Rise Test

Apply 400 amperes through each mated connector set for duration of 30-minutes. Record temperature rise at surface of each mated connector set via infrared scanning equipment. Temperature rise must be less than 45 degree C.

2.5.2.6 Moisture Resistance Test

Subject the mated connectors to a water spray maintained at 5-psi, with a collection rate of 18-in/hr, at a distance of 5-feet, for one hour. Verify that no water penetrated the connection.

2.5.2.7 Dielectric Voltage Withstand Test

Wrap the mated connectors in conductive foil and apply a test potential of 2200 VAC between the conductor and the foil for a period of 5-minutes. Dielectric breakdown must constitute a failed test.

2.5.2.8 Insulation Resistance Test

Wrap the mated connectors in conductive foil and using a Megger insulation resistance tester with an open circuit output of 500 VDC, measure the insulation resistance between the conductor and foil. Resistance measurement must be greater than 100 Megohms.

2.5.3 600 V Single Pole Connector Torque Test

Conduct a torque test on three male and three female cable mount in-line connectors as follows: With the metal connector part rigidly secured, apply a rotating (twisting) force of 700 lbs on the insulating sleeve. The insulating sleeve must not break free and spin around the connector metal part. A factory-certified report of the specified tests previously performed on identical units of each rating will be acceptable.

2.5.4 Equipment Test Schedule

The Government will witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

Test Instrument Calibration

1. The manufacturer must have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
2. The accuracy must be directly traceable to the National Institute of Standards and Technology.
3. Instrument calibration frequency schedule must not exceed 12 months for both test floor instruments and leased specialty equipment.
4. Dated calibration labels must be visible on all test equipment.
5. Calibrating standard must be of higher accuracy than that of the instrument tested.
6. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

- (a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.
- (b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.5.5 [Equipment Inspection Schedule](#)

The Government will perform inspection of the equipment prior to shipment from the manufacture's facility. Submit required inspection schedule and location, and notify the Contracting Officer 30 calendar days before scheduled inspection date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 26 11 16

SECONDARY UNIT SUBSTATIONS

02/10

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360 (2010) Specification for Structural Steel Buildings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C57.12.13 (1982) Conformance Requirements for Liquid-Filled Transformers

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M (2014) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

ASTM A36/A36M (2008) Standard Specification for Carbon Structural Steel

ASTM D149 (2009) Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

ASTM D1535 (2013) Specifying Color by the Munsell System

ASTM D709 (2013) Laminated Thermosetting Materials

ASTM D877 (2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

ASTM D92 (2012b) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester

ASTM D97 (2012) Pour Point of Petroleum Products

ASTM F883 (2013) Padlocks

FM GLOBAL (FM)

FM APP GUIDE

(updated on-line) Approval Guide
<http://www.approvalguide.com/>

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
- IEEE 386 (2006; INT 1 2011) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
- IEEE C2 (2012; Errata 2012; INT 1-4 2012; INT 5-7 2013) National Electrical Safety Code
- IEEE C37.121 (2012) American National Standard for Switchgear-Unit Substations - Requirements
- IEEE C37.2 (2008) Standard for Electrical Power System Device Function Numbers, Acronyms and Contact Designations
- IEEE C37.20.1 (2002; INT 1 2005; AMD A 2005; AMD B 2006; R 2007) Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
- IEEE C37.90 (2005) Standard for Relays and Relay Systems Associated With Electric Power Apparatus
- IEEE C37.90.1 (2012) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- IEEE C57.12.00 (2010) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
- IEEE C57.12.29 (2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
- IEEE C57.12.80 (2010) Standard Terminology for Power and Distribution Transformers
- IEEE C57.12.90 (2010) Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
- IEEE C57.13 (2008) Standard Requirements for Instrument Transformers
- IEEE C57.98 (2011) Guide for Transformer Impulse Tests

- IEEE C62.11 (2012) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)
- INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
- ICEA S-90-661 (2012) Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cables for Use in General Purpose and LAN Communications Wiring Systems Technical Requirements
- INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)
- IEC 61131-3 (2013) Programmable Controllers - Part 3: Programming Languages
- NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
- NEMA ICS 5 (2000; R 2010) Control Circuit and Pilot Devices
- NEMA ICS 6 (1993; R 2011) Enclosures
- NEMA LI 1 (1998; R 2011) Industrial Laminating Thermosetting Products
- NEMA ST 20 (1992; R 1997) Standard for Dry-Type Transformers for General Applications
- NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
- NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3 2014) National Electrical Code
- ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)
- OECD Test 203 (1992) Fish Acute Toxicity Test
- TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)
- TIA-232 (1997f; R 2002) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
- TIA-485 (1998a; R 2003) Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems
- TIA-568-C.2 (2009; Errata 2010) Balanced Twisted-Pair Telecommunications Cabling and Components Standards
- THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)
- SSPC SP 10/NACE No. 2 (2007) Near-White Blast Cleaning

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

- EPA 600/4-90/027F (1993) Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms
- EPA 712-C-98-075 (1998) Fate, Transport and Transformation Test Guidelines - OPPTS 835.3100- "Aerobic Aquatic Biodegradation"

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

- 10 CFR 431 Energy Efficiency Program for Certain Commercial and Industrial Equipment

UNDERWRITERS LABORATORIES (UL)

- UL 1558 (1999; Reprint Apr 2010) Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
- UL 444 (2008; Reprint Apr 2010) Communications Cables
- UL 489 (2013) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
- UL 50 (2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations
- UL 67 (2009; Reprint Jan 2013) Standard for Panelboards
- UL 869A (2006) Reference Standard for Service Equipment

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS apply to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, must be as defined in IEEE 100.

1.4 SUBMITTALS

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

SD-02 Shop Drawings

Secondary Unit Substation Drawings; G

Transformer Drawings; G

SD-03 Product Data

Secondary Unit Substation excluding transformer data; G

Transformer; G

Submittal must include manufacturer's information for each component, device, and accessory provided with the transformer.

Switchgear; G

SD-07 Certificates

Paint Coating System; G

Transformer Efficiencies; G

SD-09 Manufacturer's Field Reports

Switchgear Design Tests; G

Switchgear Production Tests; G

Transformer Design Tests; G

Transformer Acceptance Tests; G

Transformer Routine and Other Tests; G

SD-10 Operation and Maintenance Data

Secondary Unit Substation O & M; G

SD-11 Closeout Submittals

Local O & M Manuals; G

Equipment Test Schedule; G

Equipment Inspection Schedule; G

1.4.1 Government Reduced Submittal

Code CI47, NAVFAC LANT, Naval Facilities Engineering Command will review and approve all submittals in this section requiring Government approval.

1.4.2 Reduced Submittal Requirements

As an exception to the transformer submittal requirements specified herein, liquid-filled transformers manufactured by ABB in South Boston, VA; by Cooper Power Systems in Waukesha, WI; or by Howard Industries in Laurel, MS need not meet the submittal requirements of this contract. Instead, the following must be submitted:

- a. A certification, from the manufacturer, that the technical requirements of this specification must be met.

- b. An outline drawing of the transformer with devices identified (paragraph entitled "Transformer Drawings," item a).
- c. ANSI nameplate data of the transformer (paragraph entitled "Transformer Drawings", item b).
- d. Routine and other tests (paragraph entitled "Routine and Other Tests"), must be conducted by the manufacturer and may be witnessed by the government (paragraph entitled "Source Quality Control"). Provide transformer test schedule required by submittal item "SD-11 Closeout Submittals". Provide certified copies of the tests.
- e. Provide acceptance test reports required by submittal item "SD-06 Test Reports".
- f. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data".

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

1.5.1.1 Secondary Unit Substation Drawings

Drawings must include, but are not limited to the following:

- a. An outline drawing, with front, top, and side views showing incoming, transformer, outgoing and switchgear sections.
- b. One-line diagram showing current transformers, meters, and ampere rating of bus bars.
- c. Three-line diagrams, elementary diagrams, and wiring diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.
- d. Bill of materials covering major components. There must be a direct and specific correlation between the bill of material and the schematic diagrams so that the items on the schematic diagrams may be easily identified on the bill of material.

1.5.1.2 Transformer Drawings

Drawings must include, but are not limited to the following:

- a. An outline drawing, with front, top, and side views.
- b. ANSI nameplate data.

1.5.2 Paint Coating System

Submit [IEEE C57.12.29](#) coating system performance requirement tests. When switchgear and transformer are provided by two different manufacturers, each one must provide certification.

1.5.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory

provisions to be mandatory, as though the word, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site must not be used, unless specified otherwise.

1.6 MAINTENANCE

1.6.1 Secondary Unit Substation O & M

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, Data Package 5 and as specified herein.

1.6.2 Local O & M Manuals

Provide local operations and maintenance manuals at each secondary unit substation. Manuals must be assembled in a durable, hard covered, water resistant binder. The manual must be assembled and indexed in the order noted in a table of contents. The contents of the local operation and maintenance manuals must be as follows:

- a. Manufacturer's O&M information required by the paragraph entitled, "SD-10 Operation and Maintenance Data."
- b. Catalog data required by the paragraph entitled, "SD-03 Product Data."
- c. Drawing required by the paragraph entitled, "SD-02 Shop Drawings."
- d. Price for spare parts and supply list.
- e. Routine and field acceptance test reports.

1.7 WARRANTY

The equipment items must be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 SECONDARY UNIT SUBSTATION

Secondary unit substations must comply with [IEEE C37.121](#) regardless of the kVA rating specified. Substations must consist of one incoming section, one transformer section, and one outgoing section. Substation must be designed for outdoor service with ventilation openings and gasketing provided to ensure a weatherproof assembly under rain, snow, sleet, and hurricane conditions. Substations must be subassembled and coordinated by one manufacturer and must be shipped in complete sections ready for connection at the site. Where practicable, substation must be shipped as one unit. External doors must have provisions for padlocking.

2.1.1 Incoming Section

The incoming section must consist of an air-filled terminal chamber for connecting the incoming circuit directly to the transformer. If required for proper connection and alignment, include a transition section with the incoming section.

2.1.1.1 Incoming Section Enclosure

The incoming section enclosure must be [NEMA ICS 6](#) Type 3R, fabricated entirely of [ASTM A240/A240M](#) type 304 or 304L stainless steel. Paint enclosure [ASTM D1535](#) light gray No. 61 or No. 49. Paint coating system must comply with [IEEE C57.12.29](#).

2.1.1.2 Cable Terminations

[IEEE 386](#). Insulated High-Voltage Connectors. Connectors must have steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

- a. 600 ampere deadbreak connector ratings: Voltage: 15 kV, 95 kV BIL.
Connectors must have 200 ampere bushing interface for surge arresters.

2.1.1.3 Surge Arresters

[IEEE C62.11](#), rated 15kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging into inserts.

2.1.2 Transformer Section

[ANSI C57.12.13](#). Less-flammable liquid-filled. Transformer, including the tank, radiators, flanges, base, lifting provisions, and hardware, must be fabricated of [ASTM A240/A240M](#) type 304, 304L, or 316 stainless steel. Paint coating system must comply with [IEEE C57.12.29](#).

2.1.2.1 Transformer Ratings

- a. Cooling Class: KNAN.
- b. Frequency: 60 Hz.
- c. Phases: Three phase.
- d. Rated Kilovolt Amperes: 4000 kVA
- e. Voltage Rating: 12.47kV - 480Y/277 V.
- f. Operating Voltage Range: 432V to 504V.
- g. Impedance: Minimum tested impedance must not be less than 5.32 percent at 85 degrees C.
- h. Insulation Level: 95 kV BIL
- i. Temperature Rise: 65 degree C average winding temperature rise above a 30 degree ambient.
- j. Audible Sound Levels: Audible sound levels must comply with the following:

<u>kVA Range</u>	<u>DECIBELS</u> <u>(MAX)</u>
3001-4000	64

2.1.2.2 Transformer Accessories

The transformer must have the following accessories:

- a. Six 2.5 percent full capacity taps, two above and four below rated primary voltage.
- b. Tap changer, with external side wall mounted, pad-lockable, manual type operating handle, for changing tap setting when transformer is de-energized.
- c. Dead-front high-voltage bushings; **IEEE 386**. 15 kV, 95 kV BIL. Provide 600 ampere one piece deadbreak apparatus bushings.
- d. Parking stands: Provide a parking stand near each dead-front bushing.
- e. Insulated low-voltage neutral bushing with lugs for ground cable and removable ground strap.
- f. Ground pads.
- g. Liquid-level indicator.
- h. Pressure-vacuum gage.
- i. Liquid temperature indicator.
- j. Drain and filter valves.

- k. Pressure relief device, top mounted, Qualitrol series 208.
- l. Diagrammatic stainless steel or laser-etched anodized aluminum nameplate in accordance with IEEE C57.12.00 and as modified or supplemented by this section.
- m. Transformer base with provisions for jacking and for rolling in either direction.
- n. Lifting provisions.
- o. Bolted transformer top or welded top with bolted handhole access.

2.1.2.3 Specified Transformer Efficiencies

Provide transformer efficiency calculations utilizing the actual no-load and load loss values obtained during the routine tests performed on the actual transformer(s) prepared for this project. No-load losses (NLL) must be referenced at 20 degrees C. Load losses (LL) must be referenced at 55 degrees C and at 50 percent of the nameplate load. The transformer is not acceptable if the calculated transformer efficiency is less than the efficiency indicated in the "KVA / Efficiency" table below. This table is based on requirements contained within 10 CFR 431, Subpart K.

<u>kVA</u>	<u>EFFICIENCY</u> <u>(percent)</u>
above 2500	99.50

2.1.2.4 Insulating Liquid

- a. Less-flammable transformer liquids: NFPA 70 and FM APP GUIDE for less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D92 and a dielectric strength not less than 33 kV tested per ASTM D877. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

The fluid must be a biodegradable electrical insulating and cooling liquid classified by UL and approved by FM as "less flammable" fluids. The fluid must meet the following fluid properties:

- 1. Pour point: ASTM D97, less than -15 degree C
- 2. Aquatic biodegradation: EPA 712-C-98-075, 100 percent
- 3. Trout toxicity: OECD Test 203, zero mortality of EPA 600/4-90/027F, pass

2.1.3 Outgoing Section

The outgoing secondary section must consist of a secondary transition section for connecting to a low-voltage switchgear section. Connections between the transformer bushings and the outgoing section transition bus must be made by way of flex-braid links.

2.1.3.1 Outgoing Section Enclosure

The outgoing secondary compartment enclosure must be NEMA ICS 6 Type 3R,

fabricated entirely of ASTM A240/A240M type 304 or 304L stainless steel. Paint enclosure ASTM D1535 light gray No. 61 or No. 49. Paint coating system must comply with IEEE C57.12.29.

2.1.4 Switchgear Section

IEEE C37.20.1 for metal-enclosed, low-voltage power circuit breaker type, insulated for 600 volts for use on a 480-volt system.

- a. Enclosure: must be NEMA ICS 6 Type 3R and designed in accordance with BOCA, fabricated entirely of ASTM A240/A240M Type 304 or 304L stainless steel. Enclosure frame must be bolted together, 12 gauge stainless steel. All interior and exterior covers and doors must be minimum 12 gauge stainless steel sheets. Side and top covers must be removable, front and rear covers must be hinged and provided with stainless steel pad lockable vault handles with a three-point catch. Roof must be sloped toward rear for outdoor units. Paint enclosure ASTM D1535 light gray No. 61. Paint covering system must comply with IEEE C57.12.29.
- b. Switchgear Compartments: Each unit forming part of the outgoing section structure must be a self-contained stainless-steel housing having individual breaker, instrument compartment, and a full height center and rear compartment for the bare buses and outgoing cable connections. Equip individual circuit breaker compartments with primary and secondary contacts, rails, disconnecting mechanism parts, and a cell interlock to prevent moving the removable element into or out of the "connected" position while the circuit breaker is closed. Provide an individual stainless-steel door for each breaker compartment. Provide an engraved circuit designation plate on each circuit breaker compartment door.
- c. Phase Buses and Connections: Provide a 5000 ampere, three-phase, three-wire bus-mounted on insulated supports of high-impact, non-tracking, insulating material and brace to withstand the mechanical forces exerted during short-circuit conditions when connected directly to a source having maximum of 200,000 rms amperes symmetrical available. Bus bars must be silver plated electrolytic copper of 98 percent conductivity based on 1000 amperes per square inch density minimum. Phase bus bars must be insulated with an epoxy finish coating powder providing a minimum breakdown voltage of 16,000 volts per ASTM D149. Make bus bar connections from main buses to the incoming circuit breaker studs. Equip outgoing circuit breaker studs with mechanical clamp type cable connectors for the size of cables shown.
- d. Ground Bus: Provide a copper ground bus secured to each vertical structure and extending entire length of switchgear. Include provisions for making the station ground connections.
- e. Insulated Barriers: Provide barriers in accordance with NEMA LI 1, Type GPO-3, 6.35 minimum thickness. Apply moisture resistant coating to all rough-cut edges.
- f. Air Filter: Provide permanent, all-metal, cleanable, air filters. Filters must be constructed of expanded mesh and/or wire contained in an aluminum frame.

2.1.4.1 Secondary Feeder Breakers

120 Vac electrically operated stationary, unfused, current limiting type, low-voltage power circuit breaker with a short-circuit current rating of 200,000 rms amperes symmetrical at 508 volts with ampere frame rating (AF) as indicated.

2.1.4.2 Electronic Trip Units

Equip each low-voltage power circuit breaker with a solid-state tripping system consisting of three current sensors and a microprocessor-based trip unit that will provide true rms sensing circuit protection. The trip unit ampere (AT) rating must be as indicated. The electronic trip assembly must have the following features:

- a. Breakers must have long delay pick-up and time settings, short delay pick-up and time settings, instantaneous settings, and current imbalance.
- b. Metering for individual phase currents.
- c. Metering for individual phase voltage.
- d. Provisions for transmitting the following parameters via Modbus, RTU, RS485 communications.
 1. Transmit all the measurements and calculated values.
 2. Signal the causes of tripping and alarms.

Provide two hand-held test kits.

2.1.4.3 Open Position Key Lock Provisions

The feeder circuit breaker must have provisions for open position locking using key locks.

2.1.4.4 Protection Relays - MPR

IEEE C37.90 for dielectric strength and **IEEE C37.90.1** for surge withstand capability. Provide programmable, microprocessor-based relays, enclosed in switchgear-type drawout cases. The relays must provide the equivalent of three single-phase time overcurrent relays with selectable time overcurrent curves. The relays must include the following protective functions and alarms, control, monitoring and metering, and user interface features:

- a. The relays must have the following **IEEE C37.2** device number () functions.
 1. Main Protection Relay (MPR) must include phase, neutral, residual and negative-sequence time (51P/51N/51G/51Q), and instantaneous (50P/50N/50G/50Q) overcurrent protection; and Synchronism check (25).
- b. The Main Protective Relay (MPR) must have the following monitoring, metering, and control features:
 1. Metering for real-time current, voltage, power, energy qualities.

2. Phase demand and peak demand current values
 3. Reporting fault type and trip data, including time of tripping.
 4. Recording disturbance events.
 5. The front panel must have 4 user programmable pushbutton controls.
- c. The Main Protective Relay (MPR) must have the following front panel and communication interfaces:
1. Keypad for programming and selecting measured values, calculated values, I/O status, device status, and configuration parameters on a front-panel LCD display.
 2. Front RS-232 communication port.
 3. Rear RS-232 communication port.
 4. Rear 10/100BASE-T Ethernet (RJ-45 connector)port.
 5. The relay must incorporate certified DNP3 Level 2 Slave protocol communications capability.
- d. Operation
1. Pushbutton 1: Label as "CLOSE". Pressing PB1 commands the breaker to close and "Breaker Closed" LED lites.
 2. Pushbutton 2: Label as "OPEN". Label LEDs as "Breaker Open." Pressing PB4 commands the breaker to open and "Breaker Open" LED lites.
 3. Pushbutton 3: Label as "NOT USED".
 4. Pushbutton 4: Label as "NOT USED".
- 2.1.4.5 Single Function Protection Relays - BPR
- Relay must conform to [IEEE C37.90](#) and [IEEE C37.90.1](#). Protective relays must be closed in rectangular, semiflush, switchboard-type drawout case with indicating targets.
- a. Bus Protection Relays, IEEE Device 87B: Provide solid state design, three phase, high impedance, bus differential relay.
- 2.1.4.6 Auxiliary Relays - 63X, 86
- Relay must conform to [IEEE C37.90](#) and [IEEE C37.90.1](#).
- a. Sudden Pressure Auxiliary Relay (Device 63X): Provide a multi-contact, high-speed relay operating in one-half cycle or less, suitable for semi-flush mounting, in a drawout case. Relay must have contacts rated to carry 30 amperes for one minute and 12 amperes continuously. Coils must be a long-life design with a projected service life of 40 years.
 - b. Lockout Relays, IEEE Device 86: Provide hand reset, electrically tripped, high-speed auxiliary relays as indicated. Relays must be

tripped by the indicated device and must be wired to trip the as-indicated circuit breakers and prohibit closing of the circuit breaker by local and remote controls until the lockout relay has been reset by hand to its normal position. Each relay must be provided with the number of contacts as indicated.

2.1.4.7 Automation Controller

The controller must operate serial and Ethernet communications networks. It must provide a combination of functions that include digital input and digital output support, deterministic logic processing, automatic transmission of outgoing messages and processing of responses, data scaling, data aggregation, simultaneous collection of data from multiple server devices, and simultaneous data access for multiple client (master) devices. The system must provide Modbus RTU and Modbus TCP client/server, DNP3 Level 3 serial, and DNP3 Level 3 LAN/WAN client/server protocols. Specific operational and functional requirements are as follows:

- a. The controller must have four serial ports that must be software configurable for TIA-232 or TIA-485 communications modes. Each serial port connector must have an available demodulated IRIG-B time-synchronization signal.
- b. The controller must have two Ethernet ports that can operate simultaneously on different networks through independent MAC addresses.
- c. The controller must have a integrated web-based human-machine interface (HMI) that provides visualization and control of data tags.
- d. The controller must have non-volatile memory available for user programmable retained variables.
- e. The controller must be capable of receiving synchronized phasor measurement data via the IEEE C37.118 protocol on all serial and Ethernet ports to as many as five messages per second.
- f. The controller must include an integrated IEC 61131-3 programming environment, with the ability to monitor and control every connected EtherCAT I/O module and serial or Ethernet-based intelligent electronic devices (IED) continuously.

2.1.4.8 HMI Touch Monitor

15-inch color TFT touch panel (15.0 inch viewable screen), 64K colors, 1024 x 768 XGA screen resolution, 500 MHz CPU plus Graphic Accelerator chip, NEMA 4/4X, IP-65, user replaceable backlight, 50,000 hour half-life. Modbus TCP/IP Ethernet port, USB programming port; supports Compact Flash. The monitor must display the following parameters of the associated unit substation:

- a. Complete substation 1-line with breaker open, close, trip status, and average amperes for each feeder breaker; transformer KVA and KW; phase A-B voltage.
- b. Isolated view of each circuit breaker with phase amperes and current imbalance percentage.

- c. Isolated view of the transformer with phase voltage and total power (W, VAR, VA Wh, VARh, VAh).

2.1.4.9 Electricity Meter

Provide electricity meter and sub-metering in accordance with Section 26 27 14.00 20 ELECTRICITY METERING

2.1.4.10 Instruments

2.1.4.10.1 Instrument Control Switches

Provide rotary cam-operated type with positive means of indicating contact positions. Switches must have silver-to-silver contacts enclosed in a protective cover which can be removed to inspect the contacts.

- a. CS - Breaker Control Switch: Three position, spring return action, "TRIP" - "NORMAL AFTER TRIP/NORMAL AFTER CLOSE" - "CLOSE."

2.1.4.11 Current Transformers

IEEE C57.13. Provide cassette and window type current transformers as indicated. Window type current transformers must be single ratio, 60 Hz, 600-volt insulation, and 10kV BIL. Cassette type current transformer must be front accessible from breaker compartment, 60 Hz, 600-volt insulation and 10kV BIL. Size current transformers as indicated. Continuous - thermal - current rating factor (RF) and ANSI Relay Accuracy Class must be in accordance with the following tables:

RATIO	ACCURACY CLASS	RF AT 30 DEGREES C
5000/5	C200	1.33
500/5	C50	2.00

2.1.4.12 Control Power Transformers

NEMA ST 20, general purpose, dry-type, self-cooled, resin encapsulated, nonventilated. Transformer must have 180 degrees C insulation with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformer of 115 degrees C temperature rise must be capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.

2.1.4.13 Heaters

Provide 120-volt stainless steel heaters in outgoing section. Heaters must be of sufficient capacity to control moisture condensation in the compartments, must be 250 watts minimum, and must be controlled by a thermostat located in each section. Thermostat must be industrial type, high limit, to maintain compartments within the range of 60 to 90 degrees F. Humidistat must have a range of 30 to 60 percent relative humidity.

2.1.4.14 Pushbuttons

Provide one NEMA ICS 5 rated 30 millimeter heavy duty industrial type, normally-open, momentary, red pushbutton, housed in a flush-mounted stainless steel NEMA 4X device box with a spring cover

2.1.4.15 Panelboards

UL 869A, UL 67, and UL 50 having a short-circuit current rating as indicated. Panelboards must be circuit breaker-equipped. Design must be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. Main breakers must be "separately" mounted "above" branch breakers. Where "space only" is indicated, make provisions for future installation of breakers. Directories must also indicate load served by each circuit in panelboard. Directories must also indicate source of service to panelboard (e.g., Panel PA served from Switchgear CPT). Type directories and mount in holder behind transparent protective covering.

- a. Support bus bars on bases independent of circuit breakers. Main buses and back pans must be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.
- b. Circuit Breakers must be UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker is mounted. Breaker terminals must be UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.1.4.16 Station Battery

Provide 48 VDC, maintenance free, sealed, lead-acid, totally absorbed electrotype, suitable for the DC control power requirements of the switchgear operating in an ambient temperature of 0 degrees C.

2.1.4.17 Station Battery Charger

Provide 120 volts ac, 60 Hz, enclosed, automatic equalizing, dual-rate solid-state, constant voltage type battery charger with automatic AC line compensation. DC output must be voltage regulated and current limited. Charger must have two ranges, floats and equalize, and must provide continuous taper charging and automatic battery temperature compensation. The charger must have a continuous output rating of not less than 10 amperes and must be sized to recharge the station batteries in a minimum of eight hours while providing all the control power needs of the switchgear. Enclosure must be NEMA ICS 6 Type 1. The following accessories must be included:

- a. DC ammeter
- b. DC voltmeter
- c. Equalize light
- d. AC on light
- e. Low voltage light
- f. High voltage light

- g. Equalize test button/switch
- h. AC circuit breaker
- i. Low DC voltage alarm relay
- j. High DC voltage alarm relay
- k. Current failure relay

2.1.4.18 600V Single Pole Connectors

Provide in accordance with 26 05 33 DOCKSIDE POWER CONNECTION STATIONS, paragraph 600V Single Pole Connectors.

2.1.4.19 Ethernet Cable

Provide outdoor (CMX), Cat 6 cable. Cable must be 0.57MM (#23 AWG) with a PVC jacket that is flame retardant, weather and abrasion resistant. Cable must be suitable for installation within switchgear and must comply with UL 444, TIA-568-C.2, and ICEA S-90-661 standards.

2.1.4.20 Insulated Barriers

Where insulated barriers are required by reference standards, provide barriers in accordance with NEMA LI 1, Type GPO-3, 0.25 inch minimum thickness.

2.1.4.21 Terminal Boards

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Terminal boards associated with current transformers must be short-circuiting type. Terminate conductors for current transformers with ring-tongue lugs. Terminal board identification must be identical in similar units. External wiring must be color coded consistently for similar terminal boards.

2.1.4.22 Wire Marking

Mark control and metering conductors at each end. Provide factory-installed, white, plastic tubing, heat stamped with black block type letters on factory-installed wiring. On field-installed wiring, provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Each sleeve must contain a single letter or number, must be elliptically shaped to securely grip the wire, and must be keyed in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of individual sleeves. Each wire marker must indicate the device or equipment, including specific terminal number to which the remote end of the wire is attached.

2.1.5 Skid Base

Provide the incoming/transformer section and switchgear section on separate, AWS D1.1/D1.1M all welded, structural steel skid bases, constructed entirely of ASTM A36/A36M steel. Structural steel skid base including design, materials, installation, workmanship, fabrication, assembly, erection inspection, quality control, and testing must be in

accordance with **AISC 360** except as modified in this contract. All welds must be 100 percent visually inspected. All full penetration welds must be 100 percent radiographically inspected and 30 percent of all other welds must be magnetic particle tested. The structural skid must be designed to safely support the weight of each skid-mounted equipment. Provide removable lifting/jacking lug provisions at four places on each skid, located as required to properly distribute weight. Each structural skid must be designed to be lifted without the aid of a lifting frame. Stainless steel plates not less than 1/4 inch must cover entire top of skid base except under incoming cable compartments. The entire skid must be blasted clean to **SSPC SP 10/NACE No. 2** requirements (near white). Paint coating system must comply with **IEEE C57.12.29**.

2.1.6 Grounding and Bonding

Ground and bond in accordance with **NFPA 70** and **IEEE C2**.

2.1.7 Padlocks

ASTM F883. Padlocks must be provided for secondary unit substation equipment. Padlocks must be keyed as directed by the Contracting Officer.

2.2 MANUFACTURER'S NAMEPLATES

Each item of equipment must have a nameplate bearing, as a minimum, 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. Include additional information as applicable to fully identify the equipment. Nameplates must be made of noncorrosive metal. Equipment containing liquid dielectric must include the type of dielectric on the nameplate. As a minimum, provide nameplates for transformers, circuit breakers, meters, switches, and switchgear.

2.3 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each secondary unit substation, equipment enclosure, relay, switch, and device; as specified in this section or as indicated on the drawings. Each nameplate inscription must identify the function and, when applicable, the position. Nameplates must be melamine plastic, **0.125 inch** thick, white with black center core. Surface must be matte finish. Corners must be square. Accurately align lettering and engrave into the core. Minimum size of nameplates must be **one by 2.5 inches**. Lettering must be a minimum of **0.25 inch** high normal block style.

2.4 WARNING SIGNS

Provide warning signs for the enclosures of secondary unit substations having a nominal rating exceeding 600 volts.

- a. When the enclosure integrity of such equipment is specified to be in accordance with **IEEE C57.12.29**, such as for secondary unit substations, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign must be a decal and must 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" must be in white letters on a red background and the words "HIGH VOLTAGE" must be in black letters on a white background. Decal must be Panduit No. PPS0710D72 or approved equal.

- b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

2.5 SOURCE QUALITY CONTROL

2.5.1 Equipment Test Schedule

The Government will witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

Test Instrument Calibration

1. The manufacturer must have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
2. The accuracy must be directly traceable to the National Institute of Standards and Technology.
3. Instrument calibration frequency schedule must not exceed 12 months for both test floor instruments and leased specialty equipment.
4. Dated calibration labels must be visible on all test equipment.
5. Calibrating standard must be of higher accuracy than that of the instrument tested.
6. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:
 - (a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.
 - (b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.5.2 Equipment Inspection Schedule

The Government will perform inspection of the equipment prior to shipment from the manufacture's facility. Submit required inspection schedule and location, and notify the Contracting Officer 30 calendar days before scheduled inspection date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

2.5.3 Switchgear Design Tests

IEEE C37.20.1 and UL 1558.

Provide documentation showing the results of design tests on a product of the same series and rating as that provided by this specification (i.e.

5000A coated bus within stainless steel enclosure).

2.5.4 Switchgear Production Tests

IEEE C37.20.1 and UL 1558. Provide reports which include results of production tests performed on the actual equipment for this project.

2.5.5 Transformer Design Tests

In accordance with IEEE C57.12.00 and IEEE C57.12.90. Additionally, IEEE C57.12.80 section 5.1.2 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the product data and shop drawings for the specified transformer. Design tests must have been performed prior to the award of this contract.

- a. Tests must be certified and signed by a registered professional engineer.
- b. Temperature rise: "Basically the same design" for the temperature rise test means a unit-substation transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (KNAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.
- c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a unit-substation transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests must include both the primary and secondary windings of that transformer.
 1. IEEE C57.12.90 paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.
 2. State test voltage levels.
 3. Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.
- d. Lifting and moving devices: "Basically the same design" for the lifting and moving devices test means a transformer in the same weight range as the transformer specified.
- e. Pressure: "Basically the same design" for the pressure test means a unit-substation transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

2.5.6 Transformer Acceptance Tests

In accordance with IEEE C57.12.00 and IEEE C57.12.90. Submit design test reports (complete with test data, explanations, formulas, and results), performed on one of the actual transformer being provided.

- a. Tests must be certified and signed by a registered professional engineer.
- b. Temperature rise: "Basically the same design" for the temperature rise

test means a unit-substation transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (KNAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.

- c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a unit-substation transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests must include both the primary and secondary windings of that transformer.
 - 1. IEEE C57.12.90 paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.
 - 2. State test voltage levels.
 - 3. Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

2.5.7 Transformer Routine and Other Tests

In accordance with IEEE C57.12.00 and IEEE C57.12.90. Routine and other tests must be performed by the manufacturer on the actual transformer prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence must be as follows:

- a. Cold resistance measurements (provide reference temperature)
- b. Phase relation
- c. Ratio
- d. Insulation power-factor by manufacturer's recommended test method.
- e. No-load losses (NLL) and excitation current
- f. Load losses (LL) and impedance voltage
- g. Dielectric
 - 1. Impulse: Per IEEE C57.12.90 paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98. Test the primary winding only.
 - (a) State test voltage levels
 - (b) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test reports.
 - 2. Applied voltage
 - 3. Induced voltage
- h. Leak
- i. Sample insulating liquid. Sample must be tested for:

1. Dielectric breakdown voltage
 2. Acid neutralization number
 3. Specific gravity
 4. Interfacial tension
 5. Color
 6. Visual condition
 7. Water in insulating liquid
 8. Measure dissipation factor or power factor
- j. Perform dissolved gas analysis (DGA)

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 26 12 19.10

THREE-PHASE PAD-MOUNTED TRANSFORMERS

02/12

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

- ASTM A240/A240M (2014) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
- ASTM D1535 (2013) Specifying Color by the Munsell System
- ASTM D877 (2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
- ASTM D92 (2012b) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
- ASTM D97 (2012) Pour Point of Petroleum Products

FM GLOBAL (FM)

- FM APP GUIDE (updated on-line) Approval Guide
<http://www.approvalguide.com/>

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
- IEEE 386 (2006; INT 1 2011) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
- IEEE C2 (2012; Errata 2012; INT 1-4 2012; INT 5-7 2013) National Electrical Safety Code
- IEEE C37.47 (2011) Standard for High Voltage Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches
- IEEE C57.12.00 (2010) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
- IEEE C57.12.29 (2014) Standard for Pad-Mounted Equipment

- Enclosure Integrity for Coastal Environments

- IEEE C57.12.34 (2009) Standard for Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 5 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15 kV Nominal System Voltage and Below
- IEEE C57.12.90 (2010) Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
- IEEE C57.98 (2011) Guide for Transformer Impulse Tests
- IEEE C62.11 (2012) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3 2014) National Electrical Code

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

- OECD Test 203 (1992) Fish Acute Toxicity Test

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

- EPA 712-C-98-075 (1998) Fate, Transport and Transformation Test Guidelines - OPPTS 835.3100- "Aerobic Aquatic Biodegradation"
- EPA 821-R-02-012 (2002) Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms

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

- 10 CFR 431 Energy Efficiency Program for Certain Commercial and Industrial Equipment

UNDERWRITERS LABORATORIES (UL)

- UL 467 (2007) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS apply to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, must be as defined in

IEEE 100.

1.4 SUBMITTALS

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

SD-02 Shop Drawings

Pad-Mounted Transformer Drawings; G

SD-03 Product Data

Pad-Mounted Transformers; G

Submittal must include manufacturer's information for each component, device, insulating fluid, and accessory provided with the transformer.

SD-07 Certificates

Transformer Efficiencies; G

Submit certification, including supporting calculations, from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Efficiencies."

SD-09 Manufacturer's Field Reports

Pad-Mounted Transformer Design Tests; G

Pad-Mounted Transformer Routine and Other Tests; G

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

SD-11 Closeout Submittals

Transformer Test Schedule; G

Submit report of test results as specified by paragraph entitled "Field Quality Control."

1.4.1 Reduced Submittal Requirements

Transformers designed and manufactured by ABB in Jefferson City, MO; by Cooper Power Systems in Waukesha, WI; by ERMCO in Dyersburg, TN; or by Howard Industries in Laurel, MS need not submit the entire submittal package requirements of this contract. Instead, the following items must be submitted:

- a. A certification, signed by the manufacturer, stating that the technical requirements of this specification must be met.

- b. An outline drawing of the transformer with devices identified (paragraph entitled "Pad-Mounted Transformer Drawings", item a).
- c. ANSI nameplate data of the transformer (paragraph entitled "Pad-Mounted Transformer Drawings", item b).
- d. Routine and other tests (in PART 2, see paragraph entitled "Source Quality Control", subparagraph entitled "Routine and Other Tests"), must be conducted by the manufacturer and may be witnessed by the government. Provide transformer test schedule required by submittal item "SD-11 Closeout Submittals". Provide certified copies of the tests.
- e. Provide acceptance test reports required by submittal item "SD-06 Test Reports".
- f. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data".

1.5 QUALITY ASSURANCE

1.5.1 Pad-Mounted Transformer Drawings

Drawings must indicate, but not be limited to the following:

- a. An outline drawing, with front, top, and side views.
- b. ANSI nameplate data.
- c. One-line diagram, including switch(es).
- d. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses.

1.5.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of **NFPA 70** unless more stringent requirements are specified or indicated.

1.5.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site must not be used, unless specified otherwise.

1.6 MAINTENANCE

1.6.1 Additions to Operation and Maintenance Data

In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

- a. An instruction manual with pertinent items and information highlighted
- b. An outline drawing, front, top, and side views
- c. Prices for spare parts and supply list
- d. Routine and field acceptance test reports
- e. Fuse curves for primary fuses
- g. Actual nameplate diagram
- h. Date of purchase

1.7 WARRANTY

The equipment items must be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.34, IEEE C57.12.29 and as specified herein.

2.2.1 Compartments

The high- and low-voltage compartments must be separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage, Dead-Front

High-voltage compartment must contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, six high-voltage bushing wells configured for loop feed application, load-break switch handle(s), access to oil-immersed bayonet fuses, dead-front surge arresters, tap changer handle, connector parking stands, and ground pad.

- a. Insulated high-voltage load-break connectors: **IEEE 386**, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector must have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.
- b. Bushing well inserts: **IEEE 386**, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise.
- c. Load-break switch

Radial-feed oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 12,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

- d. Provide bayonet type, oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. Bayonet fuse links must sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. In order to eliminate or minimize oil spills, the bayonet fuse assembly must include an oil retention valve inside the housing which closes when the fuse holder is removed and an external drip shield. Warning must be conspicuously displayed within the high-voltage compartment cautioning against removing or inserting fuses unless the load-break switch is in the open position and the tank pressure has been released.

Bayonet fuse assembly: 150 kV BIL.

Oil-immersed current-limiting fuses: **IEEE C37.47**; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified.

- e. Surge arresters: **IEEE C62.11**, rated 6kV (5,500V Systems) and 15kV (12,470V Systems), fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap. Provide three arresters for radial feed circuits.
- f. Parking stands: Provide a parking stand near each bushing.

2.2.1.2 Low Voltage

Low-voltage compartment must contain low-voltage bushings with NEMA spade terminals, accessories, metering, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

- a. Accessories must include drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.

- b. Metering (750kVA Only): Provide as specified in Section 26 27 14.00 20 ELECTRICITY METERING.

2.2.2 Transformer

- a. Less-flammable liquid-insulated, two winding, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.
- b. Provide transformers with the following characteristics:

NAME	LOCATION	kVA	Primary	Secondary	Frequency
T7	Switchgear House	225	5,500V	400Y/230V	50
T8	Switchgear House	225	5,500V	400Y/230V	50
T9	Pier #1	750	12,470V	480Y/277V	60
T10	Pier #1	750	12,470V	480Y/277V	60

- c. Tap changer must be externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage for transformers T7 and T8. Provide six 2.5 percent full capacity taps, two above four below rated primary voltage for transformers T9 and T10. Tap changers must clearly indicate which tap setting is in use.
- d. Minimum tested percent impedance at 85 degrees C must not be less than the following values:
 - 2.87 for units rated 225kVA
 - 5.32 for units rated 750kVA
- e. Audible sound levels must comply with the following:
 - 55 decibels for units rated 225kVA
 - 57 decibels for units rated 750kVA
- f. Transformer must include lifting lugs and provisions for jacking under base. The transformer base construction must be suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. Transformer must have its kVA rating conspicuously displayed on its enclosure. The transformer must have an insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.

2.2.2.1 Specified Transformer Efficiencies

Provide transformer efficiency calculations utilizing the actual no-load and load loss values obtained during the routine tests performed on the actual transformer(s) prepared for this project. No-load losses (NLL) must be referenced at 20 degrees C. Load losses (LL) must be referenced at 55 degrees C and at 50 percent of the nameplate load. The transformer is not acceptable if the calculated transformer efficiency is less than the efficiency as stated below. These requirements are as provided by requirements within 10 CFR 431, Subpart K.

- 99.08% for units rated 225kVA
- 99.32% for units rated 750kVA

2.2.3 Insulating Liquid

- a. Less-flammable transformer liquids: [NFPA 70](#) and [FM APP GUIDE](#) for less-flammable liquids having a fire point not less than 300 degrees C tested per [ASTM D92](#) and a dielectric strength not less than 33 kV tested per [ASTM D877](#). Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

The fluid must be a biodegradable electrical insulating and cooling liquid classified by UL and approved by FM as "less flammable" fluids. The fluid must meet the following fluid properties:

1. Pour point: [ASTM D97](#), less than -15 degree C
2. Aquatic biodegradation: [EPA 712-C-98-075](#), 100 percent
3. Trout toxicity: [OECD Test 203](#), zero mortality of [EPA 821-R-02-012](#), pass

2.2.3.1 Liquid-Filled Transformer Nameplates

Distribution transformers must be provided with nameplate information in accordance with [IEEE C57.12.00](#) and as modified or supplemented by this section.

2.2.4 Corrosion Protection

Entire transformer assembly, including tank and radiator, base, enclosure, and metering enclosure must be fabricated of stainless steel conforming to [ASTM A240/A240M](#), Type 304 or 304L. Form enclosure of stainless steel sheets. The optional use of aluminum is permitted for the metering enclosure.

Paint entire transformer assembly Munsell 7GY3.29/1.5 green. Paint coating system must comply with [IEEE C57.12.29](#) regardless of base, cabinet, and tank material. The Munsell color notation is specified in [ASTM D1535](#).

2.3 WARNING SIGNS

Provide warning signs for the enclosures of pad-mounted transformers having a nominal rating exceeding 600 volts.

- a. When the enclosure integrity of such equipment is specified to be in accordance with [IEEE C57.12.29](#), such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign must be a decal and must 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" must be in white letters on a red background and the words "HIGH VOLTAGE" must be in black letters on a white background. Decal must be Panduit No. PPS0710D72 or approved equal.

2.4 Arc Flash Warning Label

Provide warning label for the enclosure of pad-mounted transformers. Locate this self-adhesive warning label on the outside of the high voltage compartment door warning of potential electrical arc flash hazards and appropriate PPE required. The label format must be as indicated.

2.5 GROUNDING AND BONDING

UL 467. Provide grounding and bonding in accordance with NFPA 70 and IEEE C2.

2.6 SOURCE QUALITY CONTROL

2.6.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

1. The manufacturer must have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
2. The accuracy must be directly traceable to the National Institute of Standards and Technology.
3. Instrument calibration frequency schedule must not exceed 12 months for both test floor instruments and leased specialty equipment.
4. Dated calibration labels must be visible on all test equipment.
5. Calibrating standard must be of higher accuracy than that of the instrument tested.
6. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:
 - (a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.
 - (b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.6.2 Design Tests

IEEE C57.12.00 states that "design tests are made only on representative apparatus to substantiate the ratings assigned to all other apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for each of the specified transformer(s). Design tests must have been performed in accordance with IEEE C57.12.90 prior to the award of this contract.

- a. Tests must be certified and signed by a registered professional engineer.
- b. Temperature rise: "Basically the same design" for the temperature rise

test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (KNAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.

- c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests must include the primary windings only of that transformer.
 - 1. IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.
 - 2. State test voltage levels.
 - 3. Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.
- d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with IEEE C57.12.34.
- e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.
- f. Short circuit: "Basically the same design" for the short circuit test means a pad-mounted transformer with the same kVA as the transformer specified.

2.6.3 Routine and Other Tests

IEEE C57.12.00. Routine and other tests must be performed in accordance with IEEE C57.12.90 by the manufacturer on each of the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence must be as follows:

- a. Phase relation
- b. Ratio
- c. No-load losses (NLL) and excitation current
- d. Load losses (LL) and impedance voltage
- e. Dielectric
 - 1. Impulse
 - 2. Applied voltage
 - 3. Induced voltage
- f. Leak

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 26 13 00

SF6/HIGH-FIREPOINT FLUIDS INSULATED PAD-MOUNTED SWITCHGEAR

11/14

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 A167** (1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- ASTM D1535** (2013) Specifying Color by the Munsell System
- ASTM D2472** (2000; R 2006) Standard Specification for Sulphur Hexafluoride
- ASTM D6871** (2003; R 2008) Standard Specification for Natural (Vegetable Oil) Ester Fluids Used in Electrical Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE 386** (2006; INT 1 2011) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
- IEEE C37.60** (2012) Standard Requirements for Overhead, Pad Mounted, Dry Vault and Submersible Automatic Circuit Reclosers and Fault Interrupters for Alternating Current Systems Up to 38 kV
- IEEE C37.74** (2003; Int 1 2004) Standard Requirements for Subsurface, Vault, and Pad-Mounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems Up to 38 kV
- IEEE C57.12.29** (2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
- IEEE C62.11** (2012) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 61099 (2010; ED 2.0) Insulating Liquids - Specifications for Unused Synthetic Organic Esters for Electrical Purposes

IEC 62271-111 (2012; ED 2.0) High Voltage Switchgear And Controlgear - Part 111: Automatic Circuit Reclosers and Fault Interrupters for Alternating Current Systems up to 38 kV

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS apply to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Switched Way

A switched way is considered a three-phase circuit entrance to the bus through a switch. For single-phase switches, it is a single-phase entrance to the bus through a switch.

1.4 SUBMITTALS

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

SD-02 Shop Drawings

Switchgear Drawings; G

SD-03 Product Data

Electronic Overcurrent Control Curves; G

SF6/High-Firepoint Fluid Insulated Pad-Mounted Switchgear; G

Include data on switches and associated accessories with each submittal. Include manufacturer's information for each component, device and accessory provided with the equipment with each submittal.

Insulated High-Voltage Connectors; G

Surge Arresters; G

SD-07 Certificates

Paint Coating System; G

SD-09 Manufacturer's Field Reports

Switchgear Design and Production Tests; G

SD-10 Operation and Maintenance Data

SF6/High-Firepoint Fluid Insulated Pad-Mounted Switchgear, Data Package 5; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.5 QUALITY ASSURANCE

1.5.1 Switchgear Drawings

Furnish drawings that include, but are not limited to, the following:

- a. Overall dimensions, weights, plan view, and front view
- b. Ratings
- c. Single-line diagram.

1.5.2 Paint Coating System

Submit IEEE C57.12.29 paint coating system performance requirement tests.

1.5.3 Electronic Overcurrent Control Curves

Provide time-current characteristic curves in PDF format and in electronic format suitable for import or updating into the SKM PowerTools for Windows computer program).

1.6 MAINTENANCE

1.6.1 SF6/High-Firepoint Fluid Insulated Pad-mounted Switchgear Operation and Maintenance

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 SF6/HIGH-FIREPOINT FLUID INSULATED PAD-MOUNTED SWITCHGEAR

IEEE C37.74.

2.1.1 Ratings and Test Requirements

The voltage rating of the switchgear must be 15.5 kV. Provide the corresponding ratings associated with the required switchgear voltage rating as follows:

Rated Maximum Voltage, kV	15.5
Rated Withstand Impulse Voltage, kV BIL	95
Continuous and Load Interrupting Current, A	600
Short-Time Current, kA rms Sym	12.5

Short-Circuit interrupting Current, kA rms Sym	12.5
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2.1.2 Switchgear Construction

Provide switchgear with switch contacts and cable entrance terminations contained in a sealed, dielectric-filled stainless steel tank. Switchgear must be shipped factory filled with appropriate levels of SF6 gas conforming to [ASTM D2472](#) or less-flammable, high-firepoint biodegradable fluid conforming to [ASTM D6871](#) and [IEC 61099](#). Configure switchgear with load interrupting and fault interrupting switched ways as indicated. Provide switchgear with front accessible terminations suitable for cables entering from below with manual operating provisions either mounted on the rear or capable of hookstick operation per [IEEE C37.74](#). Switch contact positions for switched ways must be visible through viewing windows in the switchgear tank located adjacent to the manual operating provisions. Provide internal gas pressure gage or fluid level gage in viewable location from switch operating handle. Provide each switched way with three position switch; Open, Closed, Ground.

2.1.2.1 Pad-mounting Provisions

Provide enclosed switchgear suitable for installation on a concrete pad. Fabricate switchgear enclosure with [ASTM A167](#) type 304 or 304L stainless steel. Enclosure base must include any part of the switchgear enclosure that is within 3 inches of concrete pad. Paint enclosure including base [ASTM D1535](#) Munsell 7GY3.29/1.5 green. Comply with [IEEE C57.12.29](#) for the paint coating system regardless of equipment material.

2.1.3 Load Interrupting Switched Ways

2.1.3.1 Three-Pole Group Operated Switched Ways

Provide three-pole group operated load interrupting switched ways as indicated.

2.1.3.2 Fault Interrupting Switched Ways

[IEEE C37.60](#), [IEC 62271-111](#). Provide non-fused, non-reclosing, manual reset, vacuum interrupters consisting of vacuum interrupter and a spring assisted operating mechanism. Each fault interrupting switched way must utilize internally mounted current transformers and an electronic overcurrent control to provide three-pole ganged tripping for single-phase and three-phase faults. Provide electronic overcurrent control with provisions for a minimum of ten field changeable overcurrent trip settings. Provide remote tripping via an external dry contact device for fault interrupting switched ways. Provide 120 Vac remote trip control power.

2.1.4 Low Voltage Test Pins

Provide load interrupting switch ways with internal load side voltage sensors and external test pins that allow for low voltage checks to confirm energized and in-phase conditions using a standard high-impedance voltmeter.

2.1.5 Dead-Front High-Voltage Bushings

[IEEE 386](#). 15 kV, 95 kV BIL. Provide 600 ampere one-piece deadbreak apparatus bushings for each switched way.

- a. Parking stands: Provide a parking stand near each dead-front bushing.

2.2 Insulated High-Voltage Connectors

IEEE 386. Provide corresponding connector for each switched way. Provide a grounding eye and test point on each connector.

- a. 600 Ampere deadbreak connector ratings: Voltage: 15 kV, 95 kV BIL. Short time rating: 25,000 rms symmetrical amperes. Provide connectors with 200 ampere bushing interface.

2.3 Surge Arresters

IEEE C62.11, rated 15 kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging into inserts. Provide arresters on switched ways as indicated.

2.4 SOURCE QUALITY CONTROL

2.4.1 Switchgear Design and Production Tests

Furnish reports which include results of design and production tests performed according to **IEEE C37.74** and **IEEE C37.60**, **IEC 62271-111**. Perform manufacturer production tests on each switchgear assembly to ensure that design performance is maintained in production.

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 26 13 13

METAL-CLAD SWITCHGEAR

04/07

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D1535 (2013) Specifying Color by the Munsell System

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.2 (2008) Standard for Electrical Power System Device Function Numbers, Acronyms and Contact Designations

IEEE C37.20.2 (1999; Corr 2000; R 2005) Standard for Metal-Clad Switchgear

IEEE C37.20.3 (2001; R 2006) Standard for Metal-Enclosed Interrupter Switchgear

IEEE C37.90 (2005) Standard for Relays and Relay Systems Associated With Electric Power Apparatus

IEEE C37.90.1 (2012) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

IEEE C57.12.28 (2014) Standard for Pad-Mounted Equipment - Enclosure Integrity

IEEE C57.13 (2008) Standard Requirements for Instrument Transformers

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60068-2-27 (2008; ED 4.0) Environmental Testing - Part 2-27: Tests - Test Ea and Guidance: Shock

IEC 60255-21-3 (1993; ED 1.0) Electrical Relays - Part 21: Vibration, Shock, Bump And Seismic Tests On Measuring Relays And Protection Equipment - Section 3: Seismic Tests

IEC 61000-4-5 (2005; ED 2.0; CORR 2009) Electromagnetic Compatibility (EMC) - Part 4-5: Testing

and Measurement Techniques - Surge Immunity Test

IEC 61131-3 (2013) Programmable Controllers - Part 3: Programming Languages

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 (1993; R 2011) Enclosures

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-232 (1997f; R 2002) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

TIA-485 (1998a; R 2003) Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS apply to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Metal-Clad Switchgear Drawings; G

SD-03 Product Data

Metal-Clad Switchgear; G

Protection Relays; G

SCADA Devices; G

SD-05 Design Data

Structural Design Report; G

SD-07 Certificates

Paint Coating System; G

SD-09 Manufacturer's Field Reports

Switchgear Design Tests; G

Switchgear Production Tests; G

SD-10 Operation and Maintenance Data

Metal-Clad Switchgear O & M; G

SD-11 Closeout Submittals

Formal Request For Settings; G

Local O & M Manuals; G

Equipment Test Schedule; G

1.4 QUALITY ASSURANCE

1.4.1 Metal-Clad Switchgear Drawings

Drawings must include, but are not limited to the following:

- a. One-line diagram.
- b. Outline drawings including front elevation, section views, footprint, and overall dimensions.
- c. Three-line diagrams and elementary diagrams and wiring diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.
- d. Bill of materials covering major components. There must be a direct and specific correlation between the bill of material and the schematic diagrams so that the items on the schematic diagrams may be easily identified on the bill of material.

1.4.2 Formal Request for Settings

- a. Where settings will be provided by the Government to achieve protection and coordination via relays and protective devices, submit a formal request for settings 30 days in advance of the date that settings will be needed.
- b. The equipment requiring protection and coordination must be installed prior to making this request.
- c. Include approved shop drawings, manufacturer's instructions to set the protective devices, and manufacturer's time-current curves.

1.5 MAINTENANCE

1.5.1 Metal-Clad Switchgear O & M

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, Data Package 5 and as specified herein.

1.5.2 Local O & M Manuals

Provide local operations and maintenance manuals at each metal-clad switchgear assembly. Manuals must be assembled in a durable, hard covered, water resistant binder. The manual must be assembled and indexed in the order noted in a table of contents. The contents of the local operation

and maintenance manuals must be as follows:

- a. Manufacturer's O&M information required by the paragraph entitled, "SD-10 Operation and Maintenance Data."
- b. Catalog data required by the paragraph entitled, "SD-03 Product Data."
- c. Drawing required by the paragraph entitled, "SD-02 Shop Drawings."
- d. Price for spare parts and supply list.

PART 2 PRODUCTS

2.1 METAL-CLAD SWITCHGEAR

IEEE C37.20.2.

2.1.1 Ratings

8kV Switchgear assembly must be rated as follows:

Rated Maximum Voltage, kV rms	8.25
Low Frequency Withstand Voltage, kV rms	36
Impulse Withstand Voltage, kV	95
Rated Frequency, Hz	50
Rated Continuous Current, A	4000
Rated Short Circuit Current (at rated maximum kV), kA rms sym.	40

15kV Switchgear assembly must be rated as follows:

Rated Maximum Voltage, kV rms	15
Low Frequency Withstand Voltage, kV rms	36
Impulse Withstand Voltage, kV	95
Rated Frequency, Hz	60
Rated Continuous Current, A	2000
Rated Short Circuit Current (at rated maximum kV), kA rms sym.	40

2.1.2 Structural Design

The equipment and anchorage/mounting must be designed to resist the structural loads defined on project drawing S-001. The design must be performed by a registered structural engineer and included in a [Structural Design Report](#) which is sealed by the designer.

2.1.3 Construction

Each major part of the primary circuit, that is, the circuit switching or interrupting devices, buses, voltage transformers, and control power transformers, must be completely enclosed by grounded metal barriers, that have no intentional openings between compartments. Cable chimneys in two high breaker sections must be mounted on the side walls of the incoming cable compartment so that access to the lower breaker cable termination bus is not obstructed

2.1.4 Enclosure

The switchgear enclosure must be [NEMA ICS 6](#), Type 1. Front and rear doors must be provided with pad lockable vault handles with a three-point catch. Paint enclosure, including bases, [ASTM D1535](#) light gray No. 61 or No. 49.

2.1.5 Bus Bars

Bus bars must be copper with silver-plated contact surfaces. Primary bus conductors must be covered with insulating material throughout.

- a. Provide minimum one-quarter by 2 inch copper ground bus secured to each vertical section along the entire length of the switchgear assembly.
- b. Provide a rear accessible grounding ball-stud on each phase of the incoming bus for each feeder breaker and on the ground bus in each cable termination compartment. Ball-studs must be Hubbell/Chance C600-2102 or T600-2364.

2.1.6 Switching and Interrupting Devices

Provide three-pole, 125 Vdc electrically operated, drawout, vacuum, AC high-voltage circuit breakers with a continuous current rating as indicated. Drawout breaker mechanism must provide four-position operation. Each position must be clearly identified by an indicator on the circuit breaker front panel.

(1) Connected Position: Primary and secondary contacts are fully engaged. Breaker must be opened before racking into or out of position.

(2) Test Position: Primary contacts are disconnected but secondary contacts remain fully engaged. Position must allow complete test and operation of the breaker without energizing the primary circuit.

(3) Disconnected Position: Primary and secondary contacts are disconnected.

(4) Withdrawn (Removed) Position: Places breaker completely out of compartment, ready for removal. Removal of the breaker must actuate a shutter assembly that isolates the primary stabs.

2.1.7 Instrument Transformers

IEEE C57.13, as applicable.

- a. Current Transformers: Minimum C-200 ANSI accuracy classification, single ratio as indicated, 50 or 60 Hz based on switchgear assembly.
- b. Potential Transformers: Transformer must be drawout type, 50 or 60 Hz based on switchgear assembly, with voltage ratings and ratios coordinated to the ratings of the associated switchgear, relays, meters, and instruments. Provide potential transformers connected with one fuse in the primary circuits. Fuses must be current limiting and sized as recommended by the potential transformer manufacturer.

2.1.8 Breaker Lifter

Provide a portable lifter rated for lifting and lowering circuit breakers from two-high cubicles. Portable lifter must have swivel casters in front

for ease of movement.

2.2 Protection Relays - FPR, TPR, BPR

IEEE C37.90 for dielectric strength and IEEE C37.90.1 for surge withstand capability. Provide programmable, microprocessor-based relays, all from the same manufacturer, enclosed in switchboard-type draw-out cases. The relays must provide the equivalent of three single-phase time overcurrent relays with selectable time overcurrent curves. The relays must include the following protective functions and alarms, control, monitoring and metering, and user interface features.

2.2.1 Protective Functions and Alarms

The relays must have the following IEEE C37.2 device number () functions.

- a. Feeder Protection Relay (FPR) must include phase, neutral, residual and negative-sequence time (51P/51N/51G/51Q), and instantaneous (50P/50N/50G/50Q) overcurrent protection; and Synchronism check (25).
- b. Transformer Protection Relay (TPR) must include phase time (51) and instantaneous (50) overcurrent protection; and restrained differential protection for up to four windings with fixed or variable percentage (87).
- c. Bus Protection Relay (BPR) must have three independent differential elements, each with two setting levels to provide for protection as well as open CT detection. The relay must include three MOVs with the ability to clamp the peak voltage to below 2000 V.

2.2.2 FPR Monitoring, Metering, and Control

The FPR and DPR must provide the following single phase monitoring and metering features and control:

- a. Metering for real-time current, voltage, power, energy quantities.
- b. Phase demand and peak demand current values.
- c. Reporting fault type and trip data, including time of tripping.
- d. Recording disturbance events.
- e. The front panel must have 4 user programmable pushbutton controls.
- f. Multiple protective group settings.

2.2.3 TPR Monitoring, Metering, and Control

The TPR must provide the following single phase monitoring and metering features and control:

- a. Metering for for real-time current, voltage, power, energy quantities, and differential quantities.
- b. Phase demand and peak demand current values.

- c. Reporting fault current level, duration, and date/time for overcurrent events through the differential protection zone.
- d. Recording disturbance events.
- e. Programmable optoisolated inputs and output contacts.
- f. Multiple protective group settings.

2.2.4 BPR Monitoring, Metering, and Control

The BPR must provide the following single phase monitoring and metering features and control:

- a. Metering for real-time phase and differential quantities.
- b. Phase demand and peak demand current values.
- c. Reporting fault current level, duration, and date/time for overcurrent events through the differential protection zone.
- d. Recording disturbance events.

2.2.5 Front Panel and Communication Interfaces

The relays must have the following front panel and communication interfaces:

- a. Keypad for programming and selecting measured values, calculated values, I/O status, device status, and configuration parameters on a front-panel LCD display.
- b. Front RS-232 communication port.
- c. Rear RS-232 communication port.
- d. Rear 10/100BASE-T Ethernet (RJ-45 connector)port (FPR and TPR only).
- e. The relay must incorporate certified DNP3 Level 2 Slave protocol communications capability.

2.2.6 Pushbutton Control Operation

- a. Pushbutton 1 : Label as "ARC FLASH". Label LEDs "Maintenance" and "Instantaneous." Pressing the pushbutton selects between Maintenance Mode and Instantaneous protective settings.
- b. Pushbutton 2: Label as "SCADA". Label LEDs as "Enabled" and "Disabled". Pressing the pushbutton selects between enabling and disabling SCADA control.
- c. Pushbutton 3: Label as "CLOSE". Pressing the pushbutton commands the breaker to close and "Breaker Closed" LED lites. Closure will be delayed 10 seconds.
- d. Pushbutton 4: Label as "TRIP." Label LEDs as "Breaker Open." Pressing the pushbutton commands the breaker to open and "Breaker Open" LED lites.

2.2.7 Auxiliary Relays

Relay must conform to [IEEE C37.90](#) and [IEEE C37.90.1](#).

- a. Lockout Relays, IEEE Device 86: Provide hand reset, electrically tripped, high-speed auxiliary relays as indicated. Relays must be tripped by the indicated device and must be wired to trip the as-indicated circuit breakers and prohibit closing of the circuit breaker by local and remote controls until the lockout relay has been reset by hand to its normal position. Each relay must be provided with the number of contacts as indicated.

2.3 SCADA Devices

2.3.1 Automation Controller

The controller must operate serial and Ethernet communications networks. It must provide a combination of functions that include digital input and digital output support, deterministic logic processing, automatic transmission of outgoing messages and processing of responses, data scaling, data aggregation, simultaneous collection of data from multiple server devices, and simultaneous data access for multiple client (master) devices. The system must provide Modbus RTU and Modbus TCP client/server, DNP3 Level 3 serial, and DNP3 Level 3 LAN/WAN client/server protocols. Specific operational and functional requirements are as follows:

- a. The controller must have four serial ports that must be software configurable for [TIA-232](#) or [TIA-485](#) communications modes. Each serial port connector must have an available demodulated IRIG-B time-synchronization signal.
- b. The controller must have two Ethernet ports that can operate simultaneously on different networks through independent MAC addresses.
- c. The controller must have a integrated web-based human-machine interface (HMI) that provides visualization and control of data tags.
- d. The controller must have non-volatile memory available for user programmable retained variables.
- e. The controller must be capable of receiving synchronized phasor measurement data via the IEEE C37.118 protocol on all serial and Ethernet ports to as many as five messages per second.
- f. The controller must include an integrated [IEC 61131-3](#) programming environment, with the ability to monitor and control every connected EtherCAT I/O module and serial or Ethernet-based intelligent electronic devices (IED) continuously.

2.3.2 Ethernet Switches

Fully managed Ethernet Modular Switches must support 10BaseFL/100BaseFX /1000BaseX fiber and 10/100/1000BaseTX copper port combinations.

2.3.3 Satellite-Synchronized Clock

Provide SEL-2407 or similar Satellite-synchronized Clock compatible with the substation server. Include GPS antenna. The satellite-synchronized clock must provide high-accuracy time in multiple formats. Self-checking functions must be included. Specific requirements are as follows:

- a. IRIG-B demodulated outputs must be within +/- 100 nanoseconds (average) and +/- 500 nanoseconds (maximum) of UTC time. Modulated output and serial port IRIG-B outputs must be +/- microsecond of UTC time.
- b. The clock must have an accuracy of +/- 0.08 ppm for 20 minutes (over the entire operating temperature range) while the clock is not locked to the GPS satellite reference. The clock must have a minimum of one modulated IRIG-B output and 6 demodulated IRIG-B outputs programmable to IRIG-B, 1 PPS, OR 1k PPS. Any of the demodulated time outputs can be programmed for UTC or local time. The clock must provide IRIG-B connection capability, as well as ASCII time output at one serial port. The clock must have automatic daylight saving time advance/return with presets for North America and Europe, or custom DST setting capability. The alarm contact must be programmable to include loss-of-satellite lock, loss of power supply, and processor self-test failure. Front-panel LEDs must display UTC or local day and time, as well as clock operational status. No proprietary software must be required to communicate with the clock. Standard PC-compatible terminal emulation programs must be sufficient to establish communication, provide commands and settings, and download data. The clock must support the capability to provide date and time to a PC or computer via a communications link using accessory software. The clock must have an operating range of -40 degrees to +80 degrees C with rated accuracy. The clock must meet and be tested for EMI, RFI, shock, vibration, and environmental compliance per the IEEE C37.90, IEC 60255-21-3, IEC 61000-4-5, and IEC 60068-2-27 standards.

2.3.4 Electronic Watthour Meter

Provide metering for low-voltage metal-clad switchgear in accordance with Section 26 27 14.00 20 ELECTRICITY METERING.

2.4 Terminal Boards

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Terminal boards associated with current transformers must be short-circuiting type. Terminate conductors for current transformers with ring-tongue lugs. Terminal board identification must be identical in similar units. External wiring must be color coded consistently for similar terminal boards.

2.5 Wire Marking

Mark control and metering conductors at each end. Provide factory-installed white plastic tubing heat stamped with black block type letters on factory-installed wiring. On field-installed wiring, provide multiple white preprinted polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Each sleeve must contain a single letter or

number, must be elliptically shaped to fit the wire securely, and must be keyed, or otherwise arranged, in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of individual sleeves. Wire markers for factory installed conductors must indicate wire designations corresponding to the schematic drawings. Wire markers on field installed conductors must indicate the device or equipment, including specific terminal number to which the remote end of the wire is attached, as well as the terminal number to which the wire is directly attached (near end/far end marking).

2.6 NAMEPLATES

Provide as specified in Section 26 00 00.00 20, BASIC ELECTRICAL MATERIALS AND METHODS.

2.7 WARNING SIGNS

Provide as specified in Section 26 00 00.00 20, BASIC ELECTRICAL MATERIALS AND METHODS.

2.8 SOURCE QUALITY CONTROL

2.8.1 Equipment Test Schedule

The Government reserves the right to witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

1. The manufacturer must have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
2. The accuracy must be directly traceable to the National Institute of Standards and Technology.
3. Instrument calibration frequency schedule must not exceed 12 months for both test floor instruments and leased specialty equipment.
4. Dated calibration labels must be visible on all test equipment.
5. Calibrating standard must be of higher accuracy than that of the instrument tested.
6. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:
 - (a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.
 - (b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.8.2 Switchgear Design Tests

IEEE C37.20.2 or IEEE C37.20.3 as applicable. Furnish documentation showing the results of design tests on a product of the same series and rating as that provided by this specification. Required tests must be as follows:

- a. Design Test
 1. Dielectric test
 2. Rated continuous current test
 3. Short-time current withstand test
 4. Short-circuit current withstand tests
 5. Mechanical endurance tests
 6. Flame-resistance tests
 7. Rod entry tests

2.8.3 Switchgear Production Tests

IEEE C37.20.2 or IEEE C37.20.3 as applicable. Furnish reports which include results of production tests performed on the actual equipment for this project. Required tests must be as follows:

- a. Production Test
 1. Dielectric test
 2. Mechanical operation tests
 3. Grounding of instrument transformer case test
 4. Electrical operation and control-wiring tests
 5. Impulse withstand test.

2.8.4 Paint Coating System

Submit coating system performance requirement test results for the roof, wall, ceiling, and door finishes. Paint coating system must comply with IEEE C57.12.28

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 26 13 14

SWITCHGEAR HOUSE

04/07

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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M (2014) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

ASTM A36/A36M (2008) Standard Specification for Carbon Structural Steel

ASTM B117 (2011) Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM D2794 (1993; R 2010) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)

ASTM D4060 (2010) Abrasion Resistance of Organic Coatings by the Taber Abraser

ASTM D4541 (2009e1) Pull-Off Strength of Coatings Using Portable Adhesion Testers

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.20.2 (1999; Corr 2000; R 2005) Standard for Metal-Clad Switchgear

IEEE C57.12.29 (2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z358.1 (2009) American National Standard for

Emergency Eyewash and Shower Equipment

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C136.10 (2010) American National Standard for Roadway and Area Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles--Physical and Electrical Interchangeability and Testing

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2012; Amendment 1 2012) Life Safety Code

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3 2014) National Electrical Code

NFPA 80 (2010; TIA 10-2) Standard for Fire Doors and Other Opening Protectives

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 10/NACE No. 2 (2007) Near-White Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL 1310 (2011; Reprint Oct 2013) UL Standard for Safety Class 2 Power Units

UL 1598 (2008; Reprint Oct 2012) Luminaires

UL 773 (1995; Reprint Mar 2002) Standard for Plug-In, Locking Type Photocontrols for Use with Area Lighting

UL 773A (2006; Reprint Nov 2013) Standard for Nonindustrial Photoelectric Switches for Lighting Control

UL 8750 (2009; Reprint Sep 2014) UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products

UL 924 (2006; Reprint Feb 2011) Standard for Emergency Lighting and Power Equipment

UL 96 (2005; Reprint Oct 2013) Standard for Lightning Protection Components

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS apply to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation;

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

SD-02 Shop Drawings

Switchgear House Drawings; G

SD-03 Product Data

Switchgear House; G

SD-07 Certificates

Paint Coating System; G

SD-10 Operation and Maintenance Data

Switchgear House O & M; G

SD-11 Closeout Submittals

Local O & M Manuals; G

Equipment Test Schedule; G

Equipment Inspection Schedule; G

1.4 QUALITY ASSURANCE

1.4.1 Switchgear House Drawings

Drawings must include, but are not limited to the following:

- a. Design drawings for building including floor plan with cable entry area, elevations, section views, and skid foundation.
- b. Building electrical plan.
- c. Bill of materials covering major components.
- d. Building lightning protection plan.

1.4.2 Paint Coating System

Submit IEEE C57.12.29 coating system performance requirement tests.

1.5 MAINTENANCE

1.5.1 Switchgear House O & M

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, Data Package 5 and as specified herein. The submitted data package must include literature for building components, mechanical and electrical components, switchgear assembly, station battery and charger.

1.5.2 Local O & M Manuals

Provide local operations and maintenance manuals at the switchgear house. Manuals must be assembled in a durable, hard covered, water resistant binder. The manual must be assembled and indexed in the order noted in a table of contents. The contents of the local operation and maintenance manuals must be as follows:

- a. Manufacturer's O&M information required by the paragraph entitled, "SD-10 Operation and Maintenance Data".
- b. Catalog data required by the paragraph entitled, "SD-03 Product Data".
- c. Drawing required by the paragraph entitled, "SD-02 Shop Drawings".

PART 2 PRODUCTS

2.1 SWITCHGEAR HOUSE

Provide a prefabricated walk-in skid-mounted switchgear house and foundation system including an insulated metal enclosure, structural steel skid, switchgear, interior power, interior and exterior lighting, heating, cooling, battery system, and related equipment. The switchgear house manufacture must provide the equipment and material as specified within this and related specifications. All equipment within the switchgear house must be totally complete, fully integrated and tested prior to the shipment and arrival to the construction site providing a turn-key package.

2.1.1 Metal Enclosure

The switchgear house enclosure must be a fabricated of [ASTM A240/A240M](#) type 304L stainless steel. There must be a minimum clear space of 18 inches above the top of the tallest interior equipment cabinet to the interior ceiling panel. Each rear accessible equipment cabinet must have a rear compartment access door. Each access door must attach to a frame which matches the width of the respective interior equipment cabinet and the frame must be bolted directly to each interior equipment cabinet. Adjacent interior switchgear sections remain isolated in accordance with [IEEE C37.20.2](#) when opening any rear access door. A "drop-over house" is not acceptable.

2.1.1.1 Design Load Criteria

Design live load must be a minimum of;

- a. Floor live load: 250 pounds per square foot.
- b. Roof live load: 30 pounds per square foot.
- c. Wind loading: 125 miles per hour.

2.1.1.2 Framing

Switchgear house must be of rigid frame type construction, with self-framing vertical walls and standing seam gable roof with maximum panel widths of 16 inches. Roof slope must be a minimum of 1 to 48. Ceiling must be independent of roof panels.

2.1.1.3 Roof, Wall, and Ceiling Panels

Roof, wall, and ceiling panel gauge must be a minimum of;

- a. Exterior panels to be 12 gauge (.105" or 2.67MM) minimum.
- b. Interior panels to be 18 gauge (.048" or 1.22MM) minimum.
- c. Flashing to be 16 gauge (.060" or 1.52MM) minimum.
- d. Standing seam roof interlocking rib height must be not less than 2.5 inches (63.5MM).
- e. Insulation in the cores of the ceiling and wall panels must be asbestos-free composition and provide an overall "U" value of not more than 0.10.

2.1.1.4 Personal Doors

The switchgear house doors must be double wall, 16 gauge stainless steel with top reinforcing panel for door closer and center reinforcing panel for exit device. Maximum deflection must be 1.57MM (0.062 inch across the width and 0.0125 across the height. Provide all hardware necessary to meet the requirements of [NFPA 80](#) for fire doors and [NFPA 101](#) for exit doors.

2.1.1.5 Paint Coating System

Paint coating system for the switchgear house must comply with [IEEE C57.12.29](#). All panel sheets and framing components must be coated prior to assembly. All interior ceiling panels must be coated with anti-condensation paint.

2.1.1.6 Skid base and Floor

The switchgear house must be mounted on a [AWS D1.1/D1.1M](#) all welded structural steel skid base, constructed entirely of [ASTM A36/A36M](#) steel. Structural steel skid base including design, materials, installation, workmanship, fabrication, assembly, erection inspection, quality control, and testing must be in accordance with [AISC 325](#). The exterior perimeter and underside of the skid base must be protected with a minimum 800 micron coating of a coal tar epoxy. The entire skid must be blasted clean to [SSPC SP 10/NACE No. 2](#) requirements prior to coating. The coating must meet the performance requirements of [ASTM D4060](#) for abrasion, [ASTM D4541](#) for adhesion, [ASTM D2794](#) for impact, and [ASTM B117](#) for salt fog. Stainless steel plates not less than 1/4 inch must cover entire top of skid base except under incoming cable compartments. Paint coating system must comply with [IEEE C57.12.29](#). After the unit is complete, the top side (floor) is painted with an epoxy paint and sand mix for the non-skid finish.

2.1.2 Interior Distribution System

Provide cables, conduits, panelboards, circuit breakers, receptacles, GFI receptacles, toggle switches, automatic transfer switch, surge protective devices, lighting contactors, and related switchgear house accessories in accordance with Section [26 20 00](#) INTERIOR DISTRIBUTION SYSTEM.

2.1.3 Interior and Exterior Lighting

2.1.3.1 Interior Lighting

2.1.3.1.1 Surface Mounted LED Luminaires

[UL 1598](#), [UL 1310](#), and [UL 8750](#). Provide surface mounted LED luminaires that are suitable for indoor applications. The luminaire must utilize efficient LEDs and drivers that produces a minimum life expectancy of 60,000 hours. The luminaire must be constructed of one-piece molded, durable fiberglass

reinforced polyester and UV-stabilized, impact resistant diffused acrylic shielding, and have an integral surge protection. The interior lighting system must provide a minimum light level of 200 lux.

2.1.3.1.2 Exit-Emergency Combo Unit

UL 924, NFPA 70, and NFPA 101. Provide low energy light emitting diode (LED) lamp sign that operates in normal, AC input, and emergency, DC input, modes of operations. Exit-emergency combo units must be integrated with adjustable twin lamps, 2-1.8 watt LED lamps, that operate in emergency, DC input, mode to provide redundant light source and battery backup. LEDs must have a rated lamp life of 10 years minimum.

2.1.3.1.2.1 Battery Backup

Sealed, maintenance-free nickel-cadium battery delivers 90 minute capacity to emergency lamps. Two-state constant current discharge that maximizes battery life and automatically recharges battery discharge. Unit must be provided with an automatic power failure device, test switch, pilot light, integral self-testing module and fully automatic high-low trickle charger in a self-contained power pack.

2.1.3.2 Wiring

Provide normal and exit-emergency combo units lighting on the same branch circuit. Wire exit-emergency combo units ahead of the local switch within the same area.

2.1.3.3 Exterior Lighting

UL 1598, UL 1310, and UL 8750. Provide wall pack LED luminaires that are suitable for outdoor applications. Mount wall pack LED luminaires exterior of the switchgear house and above personnel exit doors. Wall packs must utilize efficient LEDs and drives that produce a minimum life expectancy of 100,000 hours. Wall packs must be constructed of rugged, weather resistant, die cast aluminum housing, with an integral photocell.

2.1.3.4 Line-Voltage Photocell

UL 773 or UL 773A. Photocell must be hermetically sealed cadmium-sulfide or silicon diode type cell rated at 240VAC, 50 Hz with single pole single throw contacts. Photocell must turn on at or below 3 footcandles 30 lux and off at 22 to 107 lux. 2 to 10 footcandles Photocell housing must be exterior rated and constructed to operate within a temperature range of minus 40 to 158 degrees F. The photocell must be twist-lock receptacle type conforming to ANSI C136.10. Each photocell must be provided with solid brass prongs and voltage markings and color coding on exterior of housing.

2.1.4 Metal-Clad Switchgear

Provide in accordance with Section 26 13 13 METAL-CLAD SWITCHGEAR.

2.1.5 HVAC System

The switchgear house must be provided with self-contained, package type HVAC system. It can consist of through-the-wall type units. The system must have a free or ducted air discharge and return. The total design load for the system must include infiltration, ventilation load and heat generated

by the equipment within the hose. Provide at least 0.15 cfm/sq. feet of mechanical induced outside air for ventilation. The HVAC system must be provided with an electronic, automatic changeover thermostat. All exterior electrical apparatuses of the HVAC system must be properly sealed for security purposes.

2.1.6 Lightning Protection System

Provide ten inch copper [UL 96](#) air terminals with screw base at building roof corners. Provide [UL 96](#) Class 1 lightning protection conductors between terminals with class 1 down conductors at each corner connected to a NEMA two hole stainless steel ground pad.

2.1.7 Emergency Eyewash

[ANSI/ISEA Z358.1](#), floor supported free standing unit. Provide eyewash and stay-open ball valve operated by foot treadle or push handle. Eyewash station must have self-contained saline tank and connections compatible and interchangeable with Fendall Co. Pure Flow 1000 Emergency Eyewash Station.

2.1.8 NAMEPLATES

Provide as specified in Section [26 00 00.00 20](#), BASIC ELECTRICAL MATERIALS AND METHODS.

2.1.9 WARNING SIGNS

Provide as specified in Section [26 00 00.00 20](#), BASIC ELECTRICAL MATERIALS AND METHODS.

2.2 SOURCE QUALITY CONTROL

2.2.1 Equipment Test Schedule

The Government reserves the right to witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

1. The manufacturer must have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
2. The accuracy must be directly traceable to the National Institute of Standards and Technology.
3. Instrument calibration frequency schedule must not exceed 12 months for both test floor instruments and leased specialty equipment.
4. Dated calibration labels must be visible on all test equipment.
5. Calibrating standard must be of higher accuracy than that of the instrument tested.
6. Keep up-to-date records that indicate dates and test results of

instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

- (a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.
- (b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.2.2 [Equipment Inspection Schedule](#)

The Government will perform inspection of the equipment prior to shipment from the manufacture's facility. Submit required inspection schedule and location, and notify the Contracting Officer 30 calendar days before scheduled inspection date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM

02/14

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

- ASTM B1** (2013) Standard Specification for Hard-Drawn Copper Wire
- ASTM B8** (2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- ASTM D1535** (2013) Specifying Color by the Munsell System
- ASTM D709** (2013) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE 100** (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

- ICEA S-90-661** (2012) Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cables for Use in General Purpose and LAN Communications Wiring Systems Technical Requirements

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

- IEC 60309** Plugs, socket-outlet and couplers for industrial purposes
- IEC 60364-4-41** Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock
- CEE-7** Specification for plugs and socket-outlets for domestic and similar purpose

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- ANSI C80.1** (2005) American National Standard for Electrical Rigid Steel Conduit (ERSC)
- ANSI C80.3** (2005) American National Standard for

Electrical Metallic Tubing (EMT)

- ANSI C80.5 (2005) American National Standard for Electrical Rigid Aluminum Conduit
- NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
- NEMA FU 1 (2012) Low Voltage Cartridge Fuses
- NEMA ICS 2 (2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
- NEMA ICS 6 (1993; R 2011) Enclosures
- NEMA WD 1 (1999; R 2005; R 2010) Standard for General Color Requirements for Wiring Devices
- NEMA Z535.4 (2011) American National Standard for Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3 2014) National Electrical Code
- NFPA 70E (2012; Errata 2012) Standard for Electrical Safety in the Workplace

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

- TIA-568-C.2 (2009; Errata 2010) Balanced Twisted-Pair Telecommunications Cabling and Components Standards

UNDERWRITERS LABORATORIES (UL)

- UL 1008 (2012; Reprint Apr 2013) Transfer Switch Equipment
- UL 1449 (2006; Reprint Sep 2013) Surge Protective Devices
- UL 198M (2003; Reprint Feb 2013) Standard for Mine-Duty Fuses
- UL 20 (2010; Reprint Feb 2012) General-Use Snap Switches
- UL 4248-1 (2007; Reprint Oct 2013) UL Standard for Safety Fuseholders - Part 1: General Requirements
- UL 4248-12 (2007; Reprint Dec 2012) UL Standard for Safety Fuseholders - Part 12: Class R

UL 444	(2008; Reprint Apr 2010) Communications Cables
UL 486A-486B	(2013; Reprint Feb 2014) Wire Connectors
UL 486C	(2013; Reprint Dec 2013) Splicing Wire Connectors
UL 489	(2013) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 50	(2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations
UL 508	(1999; Reprint Oct 2013) Industrial Control Equipment
UL 510	(2005; Reprint Jul 2013) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2013) Metallic Outlet Boxes
UL 514B	(2012; Reprint Jun 2014) Conduit, Tubing and Cable Fittings
UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 67	(2009; Reprint Jan 2013) Standard for Panelboards
UL 6A	(2008; Reprint May 2013) Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel
UL 797	(2007; Reprint Dec 2012) Electrical Metallic Tubing -- Steel
UL 83	(2014) Thermoplastic-Insulated Wires and Cables
UL 869A	(2006) Reference Standard for Service Equipment
UL 891	(2005; Reprint Oct 2012) Switchboards
UL 943	(2006; Reprint Jun 2012) Ground-Fault Circuit-Interrupters

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS apply to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE 100.

1.4 SUBMITTALS

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

SD-02 Shop Drawings

Panelboards; G

SD-03 Product Data

Receptacles; G

Circuit Breakers; G

Switches; G

Lighting Contactor; G

Automatic Transfer Switch; G

Battery System; G

Surge Protective Devices; G

Include performance and characteristic curves.

SD-05 Design Data

Battery Power Calculations; G

SD-06 Test Reports

600-Volt Wiring Test; G

Grounding System Test; G

Ground-Fault Receptacle Test; G

SD-07 Certificates

Fuses; G

1.5 QUALITY ASSURANCE

1.5.1 Fuses

Submit coordination data as specified in paragraph, FUSES of this section.

1.5.2 1.4.1 Battery Power Calculations

Submit capacity calculations for battery charger and batteries. Calculation must verify that battery capacity exceeds station d.c. power requirements.

1.5.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.
- b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
- c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable.

1.6 WARRANTY

Provide equipment items supported by service organizations that are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

As a minimum, meet requirements of UL, where UL standards are established

for those items, and requirements of NFPA 70 for all materials, equipment, and devices.

2.2 CONDUIT AND FITTINGS

Conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

ANSI C80.1, UL 6.

2.2.1.2 Rigid Aluminum Conduit

ANSI C80.5, UL 6A.

2.2.2 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797, ANSI C80.3.

2.2.3 Fittings for Metal Conduit and EMT Conduit

UL 514B.

2.2.3.1 Fittings for Rigid Metal Conduit

Provide threaded-type. Split couplings are not acceptable.

2.2.3.2 Fittings for EMT

Provide die castcompression type.

2.3 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated.

2.4 JUNCTION BOXES AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.5 WIRES AND CABLES

Provide wires and cables in accordance applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Do not use wires and cables manufactured more than 12 months prior to date of delivery to site.

2.5.1 Conductors

Provide the following:

- a. Conductor sizes and capacities shown are based on copper.
- b. Conductors 10MM2 (#8 AWG) and larger diameter: stranded.
- c. Conductors 6MM2 (#10 AWG) and smaller diameter: solid.

- d. Conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3: stranded unless specifically indicated otherwise.
- e. All conductors: Copper.

2.5.1.1 Minimum Conductor Sizes

Provide minimum conductor size in accordance with the following:

- a. Branch circuits: 4MM2 (#12 AWG).
- b. Class 1 remote-control and signal circuits: 2.5MM2 (#14 AWG).
- c. Class 2 low-energy, remote-control and signal circuits: 1.5MM2 (#16 AWG).
- d. Class 3 low-energy, remote-control, alarm and signal circuits: 0.34MM2 (#22 AWG).

2.5.2 Color Coding

Provide color coding for service, feeder, branch, control, and signaling circuit conductors.

2.5.2.1 Ground and Neutral Conductors

Provide color coding of ground and neutral conductors as follows:

- a. Grounding PE conductors: Green and yellow stripes.
- b. Neutral conductors: Light Blue.

2.5.2.2 Ungrounded Conductors

Provide color coding of ungrounded conductors in different voltage systems as follows:

- a. 400Y/230 volt, three-phase
 - (1) Phase A - Brown
 - (2) Phase B - Black
 - (3) Phase C - Grey

2.5.3 Insulation

Unless specified or indicated otherwise or required by [NFPA 70](#), provide power and lighting wires rated for 600-volts, Type THWN/THHN conforming to [UL 83](#), except that grounding wire may be type TW conforming to [UL 83](#); remote-control and signal circuits: Type TW or TF, conforming to [UL 83](#). Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.5.4 Bonding Conductors

[ASTM B1](#), solid bare copper wire for sizes No. 8 AWG and smaller diameter; [ASTM B8](#), Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.6 SPLICES AND TERMINATION COMPONENTS

UL 486A-486B for wire connectors and UL 510 for insulating tapes. Connectors for 6MM2 (#10 AWG) and smaller diameter wires: insulated, pressure-type in accordance with UL 486A-486B or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.7 DEVICE PLATES

Provide the following:

- a. One-piece device plates for outlets to suit the devices installed.
- b. For metal outlet boxes, plates on unfinished walls: zinc-coated sheet steel or cast metal having round or beveled edges.
- d. Plates on metal outlet boxes: nylon or lexan, minimum 0.03 inch wall thickness and same color as receptacle or toggle switch with which they are mounted.
- c. Screws: machine-type with countersunk heads in color to match finish of plate.
- d. Sectional type device plates are not be permitted.
- e. Plates installed in wet locations: gasketed and UL listed or IP ratings for "wet locations."

2.8 TELECOMMUNICATION CABLING

2.8.1 Ethernet Cable

Provide indoor (CMG or CMR), Cat 6 cable. Cable must be 0.57MM (#23 AWG) with a PVC jacket that is flame retardant. Cable must be suitable for installation within metal-clad switchgear and must comply with UL 444, TIA-568-C.2, and ICEA S-90-661 standards.

2.9 SWITCHES

2.9.1 Toggle Switches

NEMA WD 1, UL 20, three-way, totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Include the following:

- a. Handles: ivory thermoplastic.
- b. Wiring terminals: screw-type, side-wired or of the solderless pressure type having suitable conductor-release arrangement.
- c. Contacts: silver-cadmium and contact arm - one-piece copper alloy.
- d. Switches: rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.10 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch or

panel. Coordinate time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices for proper operation. Submit coordination data for approval. Provide fuses with a voltage rating not less than circuit voltage.

2.10.1 Fuseholders

Provide in accordance with [UL 4248-1](#).

2.10.2 Cartridge Fuses, Current Limiting Type (Class R)

[UL 198M](#), Class RK-1or RK-5 time-delay type. Provide only Class R associated fuseholders in accordance with [UL 4248-12](#).

2.11 RECEPTACLES

[IEC 60309](#) and [CEE-7](#). Provide EU1-16R, "Schuko", heavy-duty, duplex, Type F style receptacle rated at 16A, 250V, 50 hertz, 2-pole, 3-wire grounding, with shuttered contacts. Provide white or ivory receptacle body.

2.11.1 Weatherproof Receptacles

Provide receptacles, IP listed for use in "wet locations". Include cast metal box with gasketed, hinged, lockable and weatherproof while-in-use, polycarbonate, UV resistant/stabilized or die-cast metal/aluminum cover plate.

2.11.2 Ground-Fault Circuit Interrupter Receptacles

[IEC 60364-4-41](#), duplex type for mounting in a standard outlet box. The device must be capable of detecting current leak of 10 milliamperes or greater and tripping by way of an adjacent residual-current device (RCD).

2.12 LOW VOLTAGE DISTRIBUTION EQUIPMENT

Provide an integrated power system enclosure that will mount adjacent to metal-clad switchgear as indicated or individually mount equipment such as, but not limited to, panelboards, lighting contactors, and automatic transfer switches to available wall space.

2.12.1 Integrated Power System Enclosure

[UL 50](#) and [UL 891](#). Provide an integrated power system enclosure rated at 400Y/230V, NEMA 1, and can withstand mechanical forces exerted during short circuit conditions when connected to a power source having an available fault current of 23kAIC. The enclosure must be capable of mounting panelboards, lighting contactors, and automatic switches. Each enclosure section must allow for top and bottom cable entry. All equipment within each enclosure section as indicated must be totally complete, fully integrated and tested prior to shipment providing a turn-key package. Paint for each enclosure section must be [ASTM D1535](#) light gray No. 61 or No. 49. Each equipment provided within the enclosure section must meet specifications as specified in the section below.

2.12.2 Individually Mounted Equipment

2.12.2.1 Panelboards

Provide panelboards in accordance with the following:

- a. **UL 67** and **UL 50** having a short-circuit current rating of 14,000 amperes symmetrical minimum.
- b. Panelboards for use as service disconnecting means: additionally conform to **UL 869A**.
- c. Panelboards: circuit breaker-equipped.
- d. Designed such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL.
- e. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings.
- f. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise.
- g. Where "space only" is indicated, make provisions for future installation of breakers.
- h. Directories: indicate load served by each circuit in panelboard.
- i. Directories: indicate source of service to panelboard (e.g., Panel PA served from Panel MDP).
- j. Type directories and mount in holder behind transparent protective covering.
- k. Panelboard nameplates: provided in accordance with paragraph FIELD FABRICATED NAMEPLATES.

2.12.2.1.1 Enclosure

Provide panelboard enclosure in accordance with the following:

- a. **UL 50**.
- b. Cabinets mounted outdoors or flush-mounted: hot-dipped galvanized after fabrication.
- c. Cabinets: painted in accordance with paragraph PAINTING.
- d. Front edges of cabinets: form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front.
- e. All cabinets: fabricated such that no part of any surface on the finished cabinet deviates from a true plane by more than **1/8 inch**.
- f. Holes: provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a **1/2 inch** clear space between the back of the cabinet and the wall

surface.

- g. Flush doors: mounted on hinges that expose only the hinge roll to view when the door is closed.
- h. Each door: fitted with a combined catch and lock, except that doors over 24 inches long provided with a three-point latch having a knob with a T-handle, and a cylinder lock.
- i. Keys: two provided with each lock, with all locks keyed alike.
- j. Finished-head cap screws: provided for mounting the panelboard fronts on the cabinets.

2.12.2.1.2 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Design main buses and back pans so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

2.12.2.1.3 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker will be mounted. Breaker terminals: UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.12.2.1.3.1 Multipole Breakers

Provide common trip-type with single operating handle. Design breaker such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.12.2.1.3.2 Circuit Breaker With Ground-Fault Circuit Interrupter

UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 10 milliamperes or greater per requirements of UL 943 for Class A ground-fault circuit interrupter.

2.12.2.1.3.3 Circuit Breakers for HVAC Equipment

Provide circuit breakers for HVAC equipment having motors (group or individual) marked for use with HACR type and UL listed as HACR type.

2.12.2.2 Automatic Transfer Switch

Provide three-pole, closed transition service rated automatic transfer switches for use in emergency systems in accordance with UL 1008. Each automatic transfer switch must be rated for total system transfer and have the current and voltage ratings as indicated. The rating of the switch must be adequate for withstanding the effects of the available RMS symmetrical fault current when protected by the indicated overcurrent device without contact welding. The switch operating mechanism must be electrically

operated from the source to which it is transferring, must have quick-make, quick-break, load break contacts, and must be mechanically held in both positions. The manual operating means must affect the opening and closing of the switch contacts at the same rate of speed as that caused by the automatic operation of the switch. The switch enclosure must comply with [UL 508](#), NEMA Type 1, and must be equipped with an equipment ground lug. Provide all the necessary controls to transfer the load to the alternate utility source upon loss of the preferred utility source and re-transfer the load to the preferred utility source when the preferred utility source returns. Provide devices mounted on cabinet front consisting of:

- a. Mode selector switch with the following positions and associated functions.
 1. TEST - Simulates loss of normal/preferred source system operation.
 2. NORMAL - Transfers system to normal/preferred source bypassing.
- b. Lamps for indicating connected source and normal/preferred source is available.
- c. Auxiliary contacts for indicating connected source and normal/preferred source available.
- d. Source selector switch with the following positions and associated functions.
 1. Source 1 - Selects Source 1 as the source to which the automatic transfer switch will transfer if that source is available.
 2. Source 2 - Selects source 2 as the source to which the automatic transfer switch will transfer if that source is available.

2.12.2.3 [Lighting Contactor](#)

[NEMA ICS 2](#), mechanically held contactor. Contacts must be rated 230 volts, 30 amperes, and poles. Coils must be rated 230 volts. Provide in NEMA 1 enclosure conforming to [NEMA ICS 6](#). Contactor must have silver alloy double-break contacts and coil clearing contacts for mechanically held contactor. Provide contactor with hand-off-automatic selector switch.

2.13 [BATTERY SYSTEM](#)

2.13.1 Station Battery

Provide 125 VDC, maintenance free, sealed, lead-acid, totally absorbed electrolyte, suitable for the DC control power requirements of the switchgear operating in an ambient temperature of 0 degrees C.

2.13.2 Station Battery Charger

Provide 230 volts ac, 50 Hz, enclosed, automatic equalizing, dual-rate solid-state, constant voltage type battery charger with automatic AC line compensation. DC output must be voltage regulated and current limited. Charger must have two ranges, floats and equalize, and must provide

continuous taper charging and automatic battery temperature compensation. The charger must have a continuous output rating of not less than 10 amperes and must be sized to recharge the station batteries in a minimum of eight hours while providing all the control power needs of the switchgear. Enclosure must be NEMA ICS 6 Type 1. The following accessories must be included:

- a. DC ammeter
- b. DC voltmeter
- c. Equalize light
- d. AC on light
- e. Low voltage light
- f. High voltage light
- g. Equalize test button/switch
- h. AC circuit breaker
- i. Low DC voltage alarm relay
- j. High DC voltage alarm relay
- k. Current failure relay

2.14 POE WEB CAMERA

Provide a ceiling mounted, power over ethernet (PoE) web camera within the switchgear house. The camera must provide high quality video and audio, pan-tilt, remote internet viewing by way of NAVSTA Rota SCADA system, and motion detection. The camera must tie into, by way of ethernet cable, network infrastructure as indicated and operate on 24VDC maximum. Below specifications for the web cam at a minimum:

- 1) Display Resolution: 640x480 Pixels
- 2) Glass Lens: 3.6MM
- 3) Pan/Tilt Angle: Horizontal (300 Degree) & Vertical (120 Degree)
- 4) Storage Temperature: -10 Degree C - 60 Degree C
- 5) Storage Humidity: 0%-90%
- 6) CPU: 2.0 Giga Hertz
- 7) Memory: 256MB
- 8) Display Card: 64MB
- 9) Operating System: Windows 2010
- 10) Image Compression: MJPEG
- 11) Image Rate: 15FPS (VGA)

- 12) Infrared Light: LEDs
- 13) Input: Built-in Microphone
- 14) Output: Built-in Speaker

2.15 GROUNDING AND BONDING EQUIPMENT

2.15.1 Ground Bus

Provide a copper ground bus bar for the connection of each equipment grounding electrode conductor. Size ground bus bar based on the number of equipment, plus ten percent, that require grounding electrode connection.

2.16 MANUFACTURER'S NAMEPLATE

Provide on each item of equipment a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.17 FIELD FABRICATED NAMEPLATES

Provide field fabricated nameplates in accordance with the following:

- a. **ASTM D709**.
- b. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings.
- c. Each nameplate inscription: identify the function and, when applicable, the position.
- d. Nameplates: melamine plastic, **0.125 inch** thick, white with black center core.
- e. Surface: matte finish. Corners: square. Accurately align lettering and engrave into the core.
- f. Minimum size of nameplates: **one by 2.5 inches**.
- g. Lettering size and style: a minimum of **0.25 inch** high normal block style.

2.18 WARNING SIGNS

Provide warning signs for flash protection in accordance with **NFPA 70E** and **NEMA Z535.4** for switchgear, panelboards, and industrial control panels and are likely to require examination, adjustment, servicing, or maintenance while energized. Provide field installed signs to warn qualified persons of potential electric arc flash hazards when warning signs are not provided by the manufacturer. Provide marking that is clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.19 SURGE PROTECTIVE DEVICES

Provide parallel type surge protective devices (SPD) which comply with **UL 1449** at the service entrance panelboards. Provide surge protectors in a

NEMA1 enclosure per NEMA ICS 6. Use Type 1 or Type 2 SPD and connect on the load side of a dedicated circuit breaker.

Provide the following modes of protection:

FOR SINGLE PHASE SYSTEMS-
Phase to phase (L-L)
Each phase to neutral (L-N)
Neutral to ground (N-G)

SPDs at the service entrance: provide with a minimum surge current rating of 80,000 amperes for L-L mode minimum and 40,000 amperes for other modes (L-N, and N-G).

Provide SPDs. Maximum L-N and N-G Voltage Protection Rating:

700V for 120/240V, single phase system

Maximum L-L Voltage Protection Rating:

1,200V for 120/240V, single phase system

The minimum MCOV (Maximum Continuous Operating Voltage) rating for L-N modes of operation: 120% of nominal voltage for 240 volts and below.

2.20 FACTORY APPLIED FINISH

Provide factory-applied finish on electrical equipment in accordance with the following:

- a. NEMA 250 corrosion-resistance test and the additional requirements as specified herein.
- b. Interior and exterior steel surfaces of equipment enclosures: thoroughly cleaned followed by a rust-inhibitive phosphatizing or equivalent treatment prior to painting.
- c. Exterior surfaces: free from holes, seams, dents, weld marks, loose scale or other imperfections.
- d. Interior surfaces: receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice.
- e. Exterior surfaces: primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish.
- f. Equipment located indoors: ANSI Light Gray.
- g. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations must conform to requirements of NFPA 70 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit: continuous from service entrance equipment to outdoor power system connection.

3.1.2 Service Entrance Identification

Service entrance disconnect devices and enclosures: labeled and identified as such.

3.1.2.1 Labels

Provide laminated plastic labels conforming to paragraph FIELD FABRICATED NAMEPLATES. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Provide service entrance disconnect devices as indicated.

3.1.3 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise.

Grounding conductor: separate from electrical system neutral conductor. Provide insulated green and yellow striped equipment grounding conductor for circuit(s) installed in conduit and raceways.

Minimum conduit size: 1/2 inch in diameter for low voltage lighting and power circuits.

3.1.3.1 Pull Wire

Install pull wires in empty conduits. Pull wire: plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.4 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs. Install conduit parallel with or at right angles to ceilings, walls, and structural members where conduit will be visible after completion of project.

3.1.4.1 Restrictions Applicable to Aluminum Conduit

- a. Do not install underground or encase in concrete or masonry.
- b. Do not use brass or bronze fittings.

3.1.4.2 Restrictions Applicable to EMT

- a. Do not install underground.
- b. Do not encase in concrete, mortar, grout, or other cementitious materials.
- c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

- d. Do not use in hazardous areas.
- e. Do not use outdoors.

3.1.4.3 Conduit Support

Support conduit by pipe straps and wall brackets. Fasten by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Do not exceed one-fourth proof test load for load applied to fasteners. Do not share supporting means between electrical raceways and mechanical piping or ducts. Where conduit crosses building expansion joints, provide suitable expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.4.4 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.5 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Provide locknuts with sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.5 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.

Boxes for metallic raceways: cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and when specifically indicated.

Boxes in other locations: sheet steel, except that aluminum boxes may be used with aluminum conduit for the conduit system. Provide each box with volume required by NFPA 70 for number of conductors enclosed in box.

Boxes for mounting lighting fixtures: minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush fixtures when required by fixture terminal operating temperature; provide readily removable fixtures for access to boxes. For surface mounted fixtures, fasten boxes and supports with machine screws or welded studs on steel.

3.1.5.1 Boxes

Boxes for use with raceway systems: minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets: minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet. Mount outlet boxes on finished walls.

3.1.5.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.6 Mounting Heights

Mount panelboards, lighting contactors, and battery station charger so the height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor. Mount receptacles 18 inches above finished floor. Mount exterior receptacles 48 inches above finished concrete pad.

3.1.7 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors 16MM2 (#6 AWG) and smaller diameter, provide color coding by factory-applied, color-impregnated insulation. For conductors 25MM2 (#4 AWG) and larger diameter, provide color coding by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with manufacturer's recommendations.

3.1.8 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.9 Covers and Device Plates

Install with edges in continuous contact with outlet box without use of mats or similar devices. Install plates with alignment tolerance of 1/16 inch.

3.1.10 Grounding and Bonding

Provide in accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic raceways and neutral conductor of wiring systems. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.10.1 Ground Bus

Provide a copper ground bus as indicated. Noncurrent-carrying metal parts of electrical equipment: effectively grounded by bonding to the ground bus. Bond the ground bus to both the entrance ground Make connections and splices of the brazed, welded, bolted, or pressure-connector type, except use pressure connectors or bolted connections for connections to removable equipment.

3.1.11 Surge Protective Devices

Connect the surge protective devices in parallel to the power source, keeping the conductors as short and straight as practically possible. Maximum allowed lead length is 3 feet.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.4 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Where field painting of enclosures for panelboards or the like is specified to match adjacent surfaces, to correct damage to the manufacturer's factory applied coatings, or to meet the indicated or specified safety criteria, provide manufacturer's recommended coatings and apply in accordance to manufacturer's instructions.

3.5 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each test.

3.5.1 Devices Subject to Manual Operation

Operate each device subject to manual operation at least five times, demonstrating satisfactory operation each time.

3.5.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring 16MM2 (#6 AWG) and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance: 250,000 ohms.

3.5.3 Ground-Fault Receptacle Test

Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.5.4 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

-- End of Section --

SECTION 26 27 14.00 20

ELECTRICITY METERING

02/11

PART 1 GENERAL

1.1 REFERENCES

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

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE C37.90.1** (2012) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- IEEE C62.41** (1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
- IEEE Stds Dictionary** (2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

- IEC 62053-22** (2003) Electricity Metering Equipment (a.c.) - Particular Requirements - Part 22: Static Meters for Active Energy (Classes 0,2 S and 0,5 S); Ed 1.0

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- ANSI C12.20** (2010) Electricity Meters - 0.2 and 0.5 Accuracy Classes
- ANSI C12.7** (2005) Requirements for Watthour Meter Sockets

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS apply to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, must be as defined in **IEEE Stds Dictionary**.

1.4 SUBMITTALS

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

SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Electricity Meters; G

The most recent meter product data must be submitted as a Technical Data Package and must be licensed to the project site. Any software must be submitted on CD-ROM and 3 hard copies of the software user manual must be submitted for each piece of software provided.

SD-10 Operation and Maintenance Data

Meter Accessories, Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

1.5 QUALITY ASSURANCE

1.5.1 Installation Drawings

Drawings must be provided in hard-copy and Adobe electronic format, and must include but not be limited to the following:

- a. Wiring diagrams with terminals identified of meter, current transformers, and fuses.

1.5.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products must have been in satisfactory commercial or industrial use for 1 year prior to bid opening. The 1-year period must include applications of equipment and materials under similar circumstances and of similar size. The product, or an earlier release of the product, must have been on sale on the commercial market through advertisements, manufacturers catalogs, or brochures during the prior 1-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.3 Material and Equipment Manufacturing Data

Products manufactured more than 1 year prior to date of delivery to site must not be used, unless specified otherwise.

1.6 MAINTENANCE

1.6.1 Meter Accessories

In addition to requirements of Data Package 5, provide the meter setup software, and the meter Modbus and DNP Register Maps on CD's to the

Contracting Officer.

1.7 SYSTEM DESCRIPTION

1.7.1 System Requirements

Electricity metering, consisting of meters and associated equipment, will be used to record the electricity consumption and other values as described in the requirements that follow and as shown on the drawings.

PART 2 PRODUCTS

2.1 ELECTRICITY METERS AND ACCESSORIES

Provide meter(s) and connect the meter(s) to the existing Advanced Metering Infrastructure (AMI) Data Acquisition System (DAS). The government will configure the meter(s).

2.1.1 Meter Connections

- a. Meter sockets must comply with ANSI C12.7
- b. Provide a 10-pole safety disconnect complete with isolation devices for the voltage and current transformer inputs, including a shorting means for the current transformers.
- c. Use #12 SIS (XHHW, or equivalent) wiring with ring lugs for all meter connections. Color code and mark the conductors as follows:
 - (1) Red - Phase A CT - C1
 - (2) Orange - Phase B CT - C2
 - (3) Brown - Phase C CT - C3
 - (4) Gray with white stripe - neutral current return - C0
 - (5) Black - Phase A voltage - V1
 - (6) Yellow - Phase B voltage - V2
 - (7) Blue - Phase C voltage - V3
 - (8) White - Neutral voltage
- d. Provide a fuse block mounted in the secondary compartment containing one fuse per phase to protect the voltage input to the watt-hour meter. Size fuses as recommended by the meter manufacturer.

2.1.2 Electricity Meters

The unit must be a microprocessor-based full four quadrant, revenue accurate meter providing true RMS measurements of voltage, current, power, energy, and demand with a combination of recording, automation, and communications capabilities. Notwithstanding any other provisions of this contract, meters must be Schneider Electric PowerLogic ION 8650 for transformers and Schneider Electric PowerLogic PM 850 for sub-metering for each shore power circuits within the secondary unit substation.

- a. ANSI C12.20, IEC 62053-22.
- b. Surge: IEEE C62.41, IEEE C37.90.1.
- c. Form factor 9S socket meter mounting.
- d. Meter must be a Class 20, transformer rated design.

- e. Meter must have three voltage and three current inputs compatible with four-wire Wye, three-wire Wye, three-wire Delta, and single-phase systems.
- f. Meter must have 4 Form C (KYZ) digital Pulse initiator outputs and 3 Form A digital inputs.
- g. Meter must be rated for use at temperature from minus 40 degrees Centigrade to plus 70 degrees Centigrade.
- h. Register-based logged data must be stored in non-volatile memory with a minimum capacity of 2MB.
- i. Demand must be measured using Sliding Window Demand modules configured to calculate the average current demand and kW, kVAR and kVA demand with interval from 1 second to several hours.
- j. Time-of-Use (TOU) programming must allow for the following:
 - a) Switchgear: 4 seasons plus 3 alternate, 6 rates, 10 day types, and 20-year calendar.
 - b) Transformer: 4 seasons, 4 rates, 5 day types, and a 20-year calendar.
- k. The meter must have three modes of operation: Normal (NORM), Alternate (ALT), and TEST. Both NORM and ALT must be display modes providing various power system data and meter property screens. TEST mode must be used to perform diagnostics and verify the meter's calibration and function.
- l. The meter must have a Ethernet (10BaseT) port, and a serial RS-232/485 port that support simultaneous data sharing with SCADA systems using Modbus and DNP 3.0 communication protocols.
- m. Setup software must allow for configuring data logging, Pulse initiator outputs, Demand, Time-of-Use, and the display features via Ethernet and serial communications to the meter, and via a front panel ANSI Type II optical port. Setup software programming must be password protected.

PART 3 EXECUTION

Not Used.

-- End of Section --