PROJECT TABLE OF CONTENTS

-- End of Project Table of Contents --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 11 00

SUMMARY OF WORK

-- End of Section Table of Contents --

SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 PROJECT LOCATION CONDITIONS

This project is for initial disaster repair and replacement of the electrical distribution and transmission system. The living and working environment will be rugged and austere. The Contractor will be responsible for base camp, housing, meals, laydown area, transportation, equipment, materials and security of the worksite and other contractor facilities.

1.2 CHANGES TO BASE BOA

Delete the text in Subpart 3.1.2 Element 2 Work Plan (Design) and replace with: No Work Plan or design is required for this project. Only design incidental to the repair and replacement activities may be required.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 33 16.00 10

DESIGN DATA (DESIGN AFTER AWARD)

-- End of Section Table of Contents --

SECTION 01 33 16.00 10

DESIGN DATA (DESIGN AFTER AWARD)

PART 1 GENERAL

1.1 CHANGES TO BASE BOA

As no work plan or design are required by this project, the Base BOA Section 01 33 16.00 10 is deleted in its entirety.

PART 2 PRODUCTS

PART 3 EXECUTION

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 33 29

SUSTAINABILITY REPORTING

-- End of Section Table of Contents --

SECTION 01 33 29

SUSTAINABILITY REPORTING

PART 1 GENERAL

1.1 CHANGES TO BASE BOA

Sustainability principles do not apply to this project; therefore, the Base BOA Section 01 33 29 is deleted in its entirety.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS

-- End of Section Table of Contents --

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.22	(2007; R 2012) Safety Requirements for Rope-Guided and Non-Guided Workers' Hoists
ASSE/SAFE A10.34	(2001; R 2012) Protection of the Public on or Adjacent to Construction Sites
ASSE/SAFE A10.44	(2014) Control of Energy Sources (Lockout/Tagout) for Construction and Demolition Operations
ASSE/SAFE Z244.1	(2003; R 2014) Control of Hazardous Energy Lockout/Tagout and Alternative Methods
ASSE/SAFE Z359.0	(2012) Definitions and Nomenclature Used for Fall Protection and Fall Arrest
ASSE/SAFE Z359.1	(2016) The Fall Protection Code
ASSE/SAFE Z359.11	(2014) Safety Requirements for Full Body Harnesses
ASSE/SAFE Z359.12	(2009) Connecting Components for Personal Fall Arrest Systems
ASSE/SAFE Z359.13	(2013) Personal Energy Absorbers and Energy Absorbing Lanyards
ASSE/SAFE Z359.14	(2014) Safety Requirements for Self-Retracting Devices for Personal Fall Arrest and Rescue Systems
ASSE/SAFE Z359.15	(2014) Safety Requirements for Single Anchor Lifelines and Fall Arresters for Personal Fall Arrest Systems
ASSE/SAFE Z359.2	(2007) Minimum Requirements for a Comprehensive Managed Fall Protection Program
ASSE/SAFE Z359.3	(2007) Safety Requirements for Positioning and Travel Restraint Systems

ASSE/SAFE Z359.4	(2013) Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and Components
ASSE/SAFE Z359.6	(2009) Specifications and Design Requirements for Active Fall Protection Systems
ASSE/SAFE Z359.7	(2011) Qualification and Verification Testing of Fall Protection Products

ASME INTERNATIONAL (ASME)

ASME B30.20	(2013; INT Oct 2010 - May 2012) Below-the-Hook Lifting Devices
ASME B30.22	(2016) Articulating Boom Cranes
ASME B30.23	(2011) Personnel Lifting Systems Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings
ASME B30.26	(2015; INT Jun 2010 - Jun 2014) Rigging Hardware
ASME B30.3	(2016) Tower Cranes
ASME B30.5	(2014) Mobile and Locomotive Cranes
ASME B30.7	(2011) Winches
ASME B30.8	(2015) Floating Cranes and Floating Derricks
ASME B30.9	(2014; INT Feb 2011 - Nov 2013) Slings

ASTM INTERNATIONAL (ASTM)

ASTM F855	(2015) Standard Specifications for Temporary Protective Grounds to Be Used on De-energized Electric Power Lines and Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1048	(2003) Guide for Protective Grounding of Power Lines
IEEE C2	(2017; Errata 1 2017) National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2013) Standard for Portable Fire Extinguishers
NFPA 241	(2013; Errata 2015) Standard for Safeguarding Construction,Alteration, and Demolition Operations

NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2) National Electrical Code
NFPA 70E	(2015; ERTA 1 2015) Standard for Electrical Safety in the Workplace

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-1019	(2012; R 2016) Standard for Installation, Alteration and Maintenance of Antenna Supporting Structures and Antennas
TIA-222	(2005G; Add 1 2007; Add 2 2009; Add 3 2014; Add 4 2014; R 2014; R 2016) Structural Standards for Steel Antenna Towers and Antenna Supporting Structures

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

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

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926-SUBPART V	Power Transmission and Distribution
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)
29 CFR 1910.333	Selection and Use of Work Practices
29 CFR 1915	Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment
29 CFR 1915.89	Control of Hazardous Energy (Lockout/Tags-Plus)
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.1400	Cranes and Derricks in Construction
29 CFR 1926.16	Rules of Construction
29 CFR 1926.450	Scaffolds
29 CFR 1926.500	Fall Protection
29 CFR 1926.552	Material Hoists, Personal Hoists, and Elevators
29 CFR 1926.553	Base-Mounted Drum Hoists

29 CFR 1926.959	Mechanical Equipment
CPL 02-01-056	(2014) Inspection Procedures for Accessing Communication Towers by Hoist
CPL 2.100	(1995) Application of the Permit-Required Confined Spaces (PRCS) Standards, 29 CFR 1910.146

1.2 DEFINITIONS

1.2.1 Competent Person (CP)

The CP is a person designated in writing, who, through training, knowledge and experience, is capable of identifying, evaluating, and addressing existing and predictable hazards in the working environment or working conditions that are dangerous to personnel, and who has authorization to take prompt corrective measures with regards to such hazards.

1.2.2 Competent Person, Cranes and Rigging

The CP, Cranes and Rigging, as defined in EM 385-1-1 Appendix Q, is a person meeting the competent person, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the Crane and Rigging Program, who through training, knowledge and experience in crane and rigging is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.3 Competent Person, Fall Protection

The CP, Fall Protection, is a person meeting the competent person requirements as defined in EM 385-1-1 Appendix Q and in accordance with ASSE/SAFE Z359.0, who has been designated in writing by the employer to be responsible for immediate supervising, implementing and monitoring of the fall protection program, who through training, knowledge and experience in fall protection and rescue systems and equipment, is capable of identifying, evaluating and addressing existing and potential fall hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.4 High Risk Activities

High Risk Activities are activities that involve work at heights, crane and rigging, excavations and trenching, scaffolding, electrical work, and confined space entry. Erection of new electric transmission and distribution lines and equipment, and the alteration, conversion, and improvement of existing transmission and distribution lines and equipment is governed by 29 CFR 1926-SUBPART V.

1.2.5 High Visibility Accident

A High Visibility Accident is any mishap which may generate publicity or high visibility.

1.2.6 Load Handling Equipment (LHE)

LHE is a term used to describe cranes, hoists and all other hoisting

equipment (hoisting equipment means equipment, including crane, derricks, hoists and power operated equipment used with rigging to raise, lower or horizontally move a load).

1.2.7 Medical Treatment

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

1.2.8 Near Miss

A Near Miss is a mishap resulting in no personal injury and zero property damage, but given a shift in time or position, damage or injury may have occurred (e.g., a worker falls off a scaffold and is not injured; a crane swings around to move the load and narrowly misses a parked vehicle).

1.2.9 Operating Envelope

The Operating Envelope is the area surrounding any crane or load handling equipment. Inside this "envelope" is the crane, the operator, riggers and crane walkers, other personnel involved in the operation, rigging gear between the hook, the load, the crane's supporting structure (i.e. ground or rail), the load's rigging path, the lift and rigging procedure.

1.2.10 Qualified Person (QP)

The QP is a person designated in writing, who, by possession of a recognized degree, certificate, or professional standing, or extensive knowledge, training, and experience, has successfully demonstrated their ability to solve or resolve problems related to the subject matter, the work, or the project.

1.2.11 Qualified Person, Fall Protection (QP for FP)

A QP for FP is a person meeting the requirements of EM 385-1-1 Appendix Q, and ASSE/SAFE Z359.0, with a recognized degree or professional certificate and with extensive knowledge, training and experience in the fall protection and rescue field who is capable of designing, analyzing, and evaluating and specifying fall protection and rescue systems.

1.2.12 USACE Property and Equipment

Interpret "USACE" property and equipment specified in USACE EM 385-1-1 as Government property and equipment.

1.2.13 Load Handling Equipment (LHE) Accident or Load Handling Equipment Mishap

A LHE accident occurs when any one or more of the eight elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; or collision, including unplanned contact between the load, crane, or other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents, even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an

accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, or roll over). Document an LHE mishap using the Crane High Hazard working group mishap reporting form.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G

SD-06 Test Reports

Monthly Exposure Reports

Notifications and Reports

Accident Reports; G

SD-07 Certificates

Crane Operators/Riggers

Standard Lift Plan; G

Critical Lift Plan; G

Naval Architecture Analysis; G

Activity Hazard Analysis (AHA)

Certificate of Compliance

1.4 MONTHLY EXPOSURE REPORTS

Provide a Monthly Exposure Report and attach to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both Prime and subcontractor. Failure to submit the report may result in retention of up to 10 percent of the voucher.

1.5 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with the most recent edition of USACE EM 385-1-1, and the following federal, state, and local laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

1.6 SITE QUALIFICATIONS, DUTIES, AND MEETINGS

1.6.1 Personnel Qualifications

1.6.1.1 Site Safety and Health Officer (SSHO)

Provide an SSHO that meets the requirements of EM 385-1-1 Section 1. The SSHO must ensure that the requirements of 29 CFR 1926.16 are met for the project. Provide a Safety oversight team that includes a minimum of one (1) person at each project site to function as the Site Safety and Health Officer (SSHO). The SSHO or an equally-qualified Alternate SSHO must be at the work site at all times to implement and administer the Contractor's safety program and government-accepted Accident Prevention Plan. The SSHO and Alternate SSHO must have the required training, experience, and qualifications in accordance with EM 385-1-1 Section 01.A.17, and all associated sub-paragraphs.

If the SSHO is off-site for a period longer than 24 hours, an equally-qualified alternate SSHO must be provided and must fulfill the same roles and responsibilities as the primary SSHO. When the SSHO is temporarily (up to 24 hours) off-site, a Designated Representative (DR), as identified in the AHA may be used in lieu of an Alternate SSHO, and must be on the project site at all times when work is being performed. Note that the DR is a collateral duty safety position, with safety duties in addition to their full time occupation.

1.6.1.1.1 Additional Site Safety and Health Officer (SSHO) Requirements and Duties

The SSHO may not serve as the Quality Control Manager. The SSHO may not serve as the Superintendent.

1.6.1.2 Competent Person Qualifications

Provide Competent Persons in accordance with EM 385-1-1, Appendix Q and herein. Competent Persons for high risk activities include confined space, cranes and rigging, excavation/trenching, fall protection, and electrical work. The CP for these activities must be designated in writing, and meet the requirements for the specific activity (i.e. competent person, fall protection).

The Competent Person identified in the Contractor's Safety and Health Program and accepted Accident Prevention Plan, must be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. Provide the credentials of the Competent Persons(s) to the the Contracting Officer for information in consultation with the Safety Office.

1.6.1.2.1 Competent Person for Fall Protection

Provide a Competent Person for Fall Protection who meets the requirements of EM 385-1-1, Section 21.C.04 and herein.

1.6.1.3 Qualified Trainer Requirements

Individuals qualified to instruct the 40 hour contract safety awareness course, or portions thereof, must meet the definition of a Competent Person Trainer, and, at a minimum, possess a working knowledge of the

following subject areas: EM 385-1-1, Electrical Standards,Lockout/Tagout, Fall Protection, Confined Space Entry for Construction; Excavation, Trenching and Soil Mechanics, and Scaffolds in accordance with 29 CFR 1926.450, Subpart L.

Instructors are required to:

a. Prepare class presentations that cover restoration-related safety requirements.

b. Ensure that all attendees attend all sessions by using a class roster signed daily by each attendee. Maintain copies of the roster for at least five (5) years. This is a certification class and must be attended 100 percent. In cases of emergency where an attendee cannot make it to a session, the attendee can make it up in another class session for the same subject.

c. Update training course materials whenever an update of the EM 385-1-1 becomes available.

d. Provide a written exam of at least 50 questions. Students are required to answer 80 percent correctly to pass.

e. Request, review and incorporate student feedback into a continuous course improvement program.

1.6.1.4 Crane Operators/Riggers

Provide Operators, Signal Persons, and Riggers meeting the requirements in EM 385-1-1, Section 15.B for Riggers and Section 16.B for Crane Operators and Signal Persons. Provide proof of current qualification.

1.6.2 Personnel Duties

1.6.2.1 Duties of the Site Safety and Health Officer (SSHO)

The SSHO must:

a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily production report. Ensure existing electrical condditions are determined prior to staring work on electrical lines and equipment.

b. Conduct mishap investigations and complete required accident reports. Report mishaps and near misses.

c. Use and maintain OSHA's Form 300 to log work-related injuries and illnesses occurring on the project site for Prime Contractors and subcontractors, and make available to the Contracting Officer upon request. Post and maintain the Form 300A on the site Safety Bulletin Board.

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

e. Review the APP and AHAs for compliance with EM 385-1-1, and approve, sign, implement and enforce them.

f. Establish a Safety and Occupational Health (SOH) Deficiency Tracking System that lists and monitors outstanding deficiencies until resolution.

g. Ensure subcontractor compliance with safety and health requirements.

h. Maintain a list of hazardous chemicals on site and their material Safety Data Sheets (SDS).

i. Maintain a weekly list of high hazard activities involving energy, equipment, excavation, entry into confined space, and elevation, and be prepared to discuss details during QC Meetings.

j. Provide and keep a record of site safety orientation and indoctrination for Contractor employees, subcontractor employees, and site visitors.

Superintendent, QC Manager, and SSHO are subject to dismissal if the above duties are not being effectively carried out. If Superintendent, QC Manager, or SSHO are dismissed, project work will be stopped and will not be allowed to resume until a suitable replacement is approved and the above duties are again being effectively carried out.

1.7 ACCIDENT PREVENTION PLAN (APP)

A qualified person must prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of EM 385-1-1, Appendix A, and as supplemented herein. Cover all paragraph and subparagraph elements in EM 385-1-1, Appendix A. The APP must be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP must interface with the Contractor's overall safety and health program referenced in the APP in the applicable APP element, and made site-specific. Describe the methods to evaluate past safety performance of potential subcontractors in the selection process. Also, describe innovative methods used to ensure and monitor safe work practices of subcontractors. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP must be signed by an officer of the firm (Prime Contractor senior person), the individual preparing the APP, the on-site superintendent, the designated SSHO, the Contractor Quality Control Manager, and any designated Certified Safety Professional (CSP) or Certified Health Physicist (CIH). The SSHO must provide and maintain the APP and a log of signatures by each subcontractor foreman, attesting that they have read and understand the APP, and make the APP and log available on-site to the Contracting Officer. If English is not the foreman's primary language, the Prime Contractor must provide an interpreter.

Submit the APP to the Contracting Officer 15calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP. Once reviewed and accepted by the Contracting Officer, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the

accepted APP is cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified. Continuously review and amend the APP, as necessary, throughout the life of the contract. Changes to the accepted APP must be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and Quality Control Manager. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered. Should any severe hazard exposure (i.e. imminent danger) become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate and remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34), and the environment.

1.7.1 Names and Qualifications

Provide plans in accordance with the requirements outlined in Appendix A of EM 385-1-1, including the following:

a. Names and qualifications (resumes including education, training, experience and certifications) of site safety and health personnel designated to perform work on this project to include the designated Site Safety and Health Officer and other competent and qualified personnel to be used. Specify the duties of each position.

b. Qualifications of competent and of qualified persons. As a minimum, designate and submit qualifications of competent persons for each of the following major areas: excavation; scaffolding; fall protection; hazardous energy; confined space; health hazard recognition, evaluation and control of chemical, physical and biological agents; and personal protective equipment and clothing to include selection, use and maintenance.

1.7.2 Plans

Provide plans in the APP in accordance with the requirements outlined in Appendix A of EM 385-1-1, including the following:

1.7.2.1 Confined Space Entry Plan

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

1.7.2.2 Standard Lift Plan (SLP)

Plan lifts to avoid situations where the operator cannot maintain safe control of the lift. Prepare a written SLP in accordance with EM 385-1-1, Section 16.A.03, using Form 16-2 for every lift or series of lifts (if duty cycle or routine lifts are being performed). The SLP must be developed, reviewed and accepted by all personnel involved in the lift in

conjunction with the associated AHA. Signature on the AHA constitutes acceptance of the plan. Maintain the SLP on the LHE for the current lift(s) being made. Maintain historical SLPs for a minimum of 3 months.

1.7.2.3 Critical Lift Plan - Crane or Load Handling Equipment

Provide a Critical Lift Plan as required by EM 385-1-1, Section 16.H.01, using Form 16-3. In addition, Critical Lift Plans are required for the following:

a. Lifts over 50 percent of the capacity of barge mounted mobile crane's hoist.

b. When working around energized power lines where the work will get closer than the minimum clearance distance in EM 385-1-1 Table 16-1.

c. For lifts with anticipated binding conditions.

d. When erecting cranes.

1.7.2.3.1 Critical Lift Plan Planning and Schedule

Critical lifts require detailed planning and additional or unusual safety precautions. Develop and submit a critical lift plan to the Contracting Officer 30 calendar days prior to critical lift. Comply with load testing requirements in accordance with EM 385-1-1, Section 16.F.03.

1.7.2.3.2 Lifts of Personnel

In addition to the requirements of EM 385-1-1, Section 16.H.02, for lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.1400 and EM 385-1-1, Section 16.T.

1.7.2.4 Barge Mounted Mobile Crane Lift Plan

Provide a Naval Architecture Analysis and include an LHE Manufacturer's Floating Service Load Chart in accordance with EM 385-1-1, Section 16.L.03.

1.7.2.5 Multi-Purpose Machines, Material Handling Equipment, and Construction Equipment Lift Plan

Multi-purpose machines, material handling equipment, and construction equipment used to lift loads that are suspended by rigging gear, require proof of authorization from the machine OEM that the machine is capable of making lifts of loads suspended by rigging equipment. Written approval from a qualified registered professional engineer, after a safety analysis is performed, is allowed in lieu of the OEM's approval. Demonstrate that the operator is properly trained and that the equipment is properly configured to make such lifts and is equipped with a load chart. Ensure all clearances to live loads are maintained.

1.7.2.6 Fall Protection and Prevention (FP&P) Plan

The plan must comply with the requirements of EM 385-1-1, Section 21.D and ASSE/SAFE Z359.2, be site specific, and address all fall hazards in the work place and during different phases of restoration. Address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 6 feet. A competent person or qualified person for fall protection must prepare and sign the plan documentation.

Include fall protection and prevention systems, equipment and methods employed for every phase of work, roles and responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods. Review and revise, as necessary, the Fall Protection and Prevention Plan documentation as conditions change, but at a minimum every six months, for lengthy projects, reflecting any changes during the course of restoration due to changes in personnel, equipment, systems or work habits. Keep and maintain the accepted Fall Protection and Prevention Plan documentation at the job site for the duration of the project. Include the Fall Protection and Prevention Plan documentation in the Accident Prevention Plan (APP).

1.7.2.7 Rescue and Evacuation Plan

Provide a Rescue and Evacuation Plan in accordance with EM 385-1-1 Section 21.N and ASSE/SAFE Z359.2, and include in the FP&P Plan and as part of the APP. Include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility.

1.7.2.8 Hazardous Energy Control Program (HECP)

Develop a HECP in accordance with EM 385-1-1 Section 12, 29 CFR 1910.147, 29 CFR 1910.333, 29 CFR 1915.89, ASSE/SAFE Z244.1, and ASSE/SAFE A10.44. Submit this HECP as part of the Accident Prevention Plan (APP). Conduct a preparatory meeting and inspection with all effected personnel to coordinate all HECP activities. Document this meeting and inspection in accordance with EM 385-1-1, Section 12.A.02. Ensure that each employee is familiar with and complies with these procedures.

1.7.2.9 Excavation Plan

Identify the safety and health aspects of excavation, and provide and prepare the plan in accordance with EM 385-1-1, Section 25.A and Section 31 00 00 EARTHWORK.

1.7.2.10 Asbestos Hazard Abatement Plan

Identify the safety and health aspects of asbestos work, and prepare in accordance with Section 02 82 13.00 10 ASBESTOS ABATEMENT.

1.7.2.11 Site Safety and Health Plan

Identify the safety and health aspects, and prepare in accordance with Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES.

1.7.2.12 PCB Plan

Identify the safety and health aspects of Polychlorinated Biphenyls work, and prepare in accordance with Sections 02 84 33 REMOVAL AND DISPOSAL OF POLYCHLORINATED BIPHENYLS (PCBs) and 02 61 23 REMOVAL AND DISPOSAL OF PCB CONTAMINATED SOILS.

1.8 ACTIVITY HAZARD ANALYSIS (AHA)

Before beginning each activity, task or Definable Feature of Work (DFOW) involving a type of work presenting hazards not experienced in previous

project operations, or where a new work crew or subcontractor is to perform the work, the Contractor(s) performing that work activity must prepare an AHA. AHAs must be developed by the Prime Contractor, subcontractor, or supplier performing the work, and provided for Prime Contractor review and approval before submitting to the Contracting Officer. AHAs must be signed by the SSHO, Superintendent, QC Manager and the subcontractor Foreman performing the work. Format the AHA in accordance with EM 385-1-1, Section 1 or as directed by the Contracting Officer. Submit the AHA for review at least 15 working days prior to the start of each activity task, or DFOW. The Government reserves the right to require the Contractor to revise and resubmit the AHA if it fails to effectively identify the work sequences, specific anticipated hazards, site conditions, equipment, materials, personnel and the control measures to be implemented.

AHAs must identify competent persons required for phases involving high risk activities, including confined entry, crane and rigging, excavations, trenching, electrical work, fall protection, and scaffolding.

1.8.1 AHA Management

Review the AHA list periodically (at least monthly) at the Contractor supervisory safety meeting, and update as necessary when procedures, scheduling, or hazards change. Use the AHA during daily inspections by the SSHO to ensure the implementation and effectiveness of the required safety and health controls for that work activity.

1.8.2 AHA Signature Log

Each employee performing work as part of an activity, task or DFOW must review the AHA for that work and sign a signature log specifically maintained for that AHA prior to starting work on that activity. The SSHO must maintain a signature log on site for every AHA. Provide employees whose primary language is other than English, with an interpreter to ensure a clear understanding of the AHA and its contents.

1.9 SITE SAFETY REFERENCE MATERIALS

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

1.10 EMERGENCY MEDICAL TREATMENT

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

1.11 NOTIFICATIONS and REPORTS

1.11.1 Mishap Notification

Notify the Contracting Officer as soon as practical, but no more than twenty-four hours, after any mishaps, including recordable accidents, incidents, and near misses, as defined in EM 385-1-1 Appendix Q, any report of injury, illness, or any property damage. For LHE or rigging mishaps, notify the Contracting Officer as soon as practical but not more than 4 hours after mishap. The Contractor is responsible for obtaining appropriate medical and emergency assistance and for notifying fire, law enforcement, and regulatory agencies. Immediate reporting is required for

electrical mishaps, to include Arc Flash; shock; uncontrolled release of hazardous energy (includes electrical and non-electrical); load handling equipment or rigging; fall from height (any level other than same surface); and underwater diving. These mishaps must be investigated in depth to identify all causes and to recommend hazard control measures.

Within notification include Contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (for example, type of construction equipment used and PPE used). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted. Assist and cooperate fully with the Government's investigation(s) of any mishap.

1.11.2 Accident Reports

Conduct an accident investigation for recordable injuries and illnesses, property damage, and near misses as defined in EM 385-1-1, to establish the root cause(s) of the accident. Complete the applicable USACE Accident Report Form 3394, and provide the report to the Contracting Officer within 5 calendar day(s) of the accident. The Contracting Officer will provide copies of any required or special forms.

1.11.3 Certificate of Compliance and Pre-lift Plan/Checklist for LHE and Rigging

Provide a FORM 16-1 Certificate of Compliance for LHE entering an activity under this contract and in accordance with EM 385-1-1. Post certifications on the crane.

1.12 CONFINED SPACE ENTRY REQUIREMENTS

Confined space entry must comply with Section 34 of EM 385-1-1, OSHA 29 CFR 1926, OSHA 29 CFR 1910, OSHA 29 CFR 1910.146, and OSHA Directive CPL 2.100. Any potential for a hazard in the confined space requires a permit system to be used.

1.12.1 Entry Procedures

Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. Comply with EM 385-1-1, Section 34 for entry procedures. Hazards pertaining to the space must be reviewed with each employee during review of the AHA.

1.12.2 Forced Air Ventilation

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

1.12.3 Rescue Procedures and Coordination with Local Emergency Responders

Develop and implement an on-site rescue and recovery plan and procedures. The rescue plan must not rely on local emergency responders for rescue

from a confined space.

~~1.13 DIVE SAFETY REQUIREMENTS~~

1.13 SEVERE STORM PLAN

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

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

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

c. Ensure that temporary erosion controls are adequate.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 RESTORATION AND OTHER WORK

Comply with EM 385-1-1, NFPA 70, NFPA 70E, NFPA 241, the APP, the AHA, Federal and State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

PPE is governed in all areas by the nature of the work the employee is performing. Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks. Safety glasses must be worn or carried/available on each person. Mandatory PPE includes:

a. Hard Hat

b. Long Pants

c. Appropriate Safety Shoes

d. Appropriate Class Reflective Vests

e. Arch Flash and Linesman Safety Equipment

3.1.1 Worksite Communication

Employees working alone in a remote location or away from other workers must be provided an effective means of emergency communications (i.e., cellular phone, two-way radios, land-line telephones or other acceptable means). The selected communication must be readily available (easily within the immediate reach) of the employee and must be tested prior to the start of work to verify that it effectively operates in the area/environment. An employee check-in/check-out communication procedure must be developed to ensure employee safety.

3.1.2 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing

ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint, and hexavalent chromium, are prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials.

3.1.3 Unforeseen Hazardous Material

Though not specifically documented, materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA and EPA regulated chemicals (i.e. 29 CFR Part 1910.1000) may be present. If material(s) that may be hazardous to human health upon disturbance are encountered during restoration operations, stop that portion of work and notify the Contracting Officer immediately. However, when PCB or asbestos are encountered execute plans provided under paragraphs ASBESTOS HAZARD ABATEMENT PLAN and PCB PLAN. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to FAR 52.243-4, "Changes" and FAR 52.236-2, "Differing Site Conditions."

3.2 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Provide and operate a Hazardous Energy Control Program (HECP) in accordance with EM 385-1-1 Section 12, 29 CFR 1910.333, 29 CFR 1915.89, and paragraph HAZARDOUS ENERGY CONTROL PROGRAM (HECP).

3.3 FALL PROTECTION PROGRAM

Establish a fall protection program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify roles and responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures in accordance with ASSE/SAFE Z359.2 and EM 385-1-1, Sections 21.A and 21.D.

3.3.1 Fall Protection Equipment and Systems

Enforce use of personal fall protection equipment and systems designated (to include fall arrest, restraint, and positioning) for each specific work activity in the Site Specific Fall Protection and Prevention Plan and AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, Section 21.

Provide personal fall protection equipment, systems, subsystems, and components that comply with EM 385-1-1 Section 21.I, 29 CFR 1926.500 Subpart M,ASSE/SAFE Z359.0, ASSE/SAFE Z359.1, ASSE/SAFE Z359.2, ASSE/SAFE Z359.3, ASSE/SAFE Z359.4, ASSE/SAFE Z359.6, ASSE/SAFE Z359.7, ASSE/SAFE Z359.11, ASSE/SAFE Z359.12, ASSE/SAFE Z359.13, ASSE/SAFE Z359.14, and ASSE/SAFE Z359.15.

3.3.1.1 Personal Fall Protection Harnesses

Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. The use of body belts is not acceptable. Harnesses must have a fall arrest

attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Snap hooks and carabiners must be self-closing and self-locking, capable of being opened only by at least two consecutive deliberate actions and have a minimum gate strength of 3,600 lbs in all directions. Use webbing, straps, and ropes made of synthetic fiber. The maximum free fall distance when using fall arrest equipment must not exceed 6 feet, unless the proper energy absorbing lanyard is used. Always take into consideration the total fall distance and any swinging of the worker (pendulum-like motion), that can occur during a fall, when attaching a person to a fall arrest system. All full body harnesses must be equipped with Suspension Trauma Preventers such as stirrups, relief steps, or similar in order to provide short-term relief from the effects of orthostatic intolerance in accordance with EM 385-1-1, Section 21.I.06. Ensure linesman body belts, safety straps, and lanyards comply with 29 CFR 1926.959.

3.3.2 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1, Section 21.F.01 and 29 CFR 1926 Subpart M.

3.3.3 Rescue and Evacuation Plan and Procedures

When personal fall arrest systems are used, ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue or assisted-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP). The plan must comply with the requirements of EM 385-1-1, ASSE/SAFE Z359.2, and ASSE/SAFE Z359.4.

3.4 EQUIPMENT

3.4.1 Material Handling Equipment (MHE)

a. Material handling equipment such as forklifts must not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions. Material handling equipment fitted with personnel work platform attachments are prohibited from traveling or positioning while personnel are working on the platform.

b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions. Material Handling Equipment Operators must be trained in accordance with OSHA 29 CFR 1910, Subpart N.

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

3.4.2 Load Handling Equipment (LHE)

The following requirements apply. In exception, these requirements do not apply to commercial truck mounted and articulating boom cranes used solely to deliver material and supplies (not prefabricated components, structural

steel, or components of a systems-engineered metal building) where the lift consists of moving materials and supplies from a truck or trailer to the ground; to cranes installed on mechanics trucks that are used solely in the repair of shore-based equipment; to crane that enter the activity but are not used for lifting; nor to other machines not used to lift loads suspended by rigging equipment. However, LHE accidents occurring during such operations must be reported.

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

b. Notify the Contracting Officer 15 working days in advance of any LHE entering the activity, in accordance with EM 385-1-1, Section 16.A.02, so that necessary quality assurance spot checks can be coordinated. Contractor's operator must remain with the crane during the spot check. Rigging gear must comply with OSHA, ASME B30.9 Standards safety standards.

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

d. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, ASME B30.8 for floating cranes and floating derricks, ASME B30.9 for slings, ASME B30.20 for below the hook lifting devices and ASME B30.26 for rigging hardware.

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

f. Do not use crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane. Additionally, submit a specific AHA for this work to the Contracting Officer. Ensure the activity and AHA are thoroughly reviewed by all involved personnel.

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

h. All employees must keep clear of loads about to be lifted and of suspended loads, except for employees required to handle the load.

i. Use cribbing when performing lifts on outriggers.

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

k. A physical barricade must be positioned to prevent personnel access where accessible areas of the LHE's rotating superstructure poses a risk of striking, pinching or crushing personnel.

l. Maintain inspection records in accordance by EM 385-1-1, Section 16.D, including shift, monthly, and annual inspections, the signature of the

person performing the inspection, and the serial number or other identifier of the LHE that was inspected. Records must be available for review by the Contracting Officer.

m. Maintain written reports of operational and load testing in accordance with EM 385-1-1, Section 16.F, listing the load test procedures used along with any repairs or alterations performed on the LHE. Reports must be available for review by the Contracting Officer.

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

o. Take steps to ensure that wind speed does not contribute to loss of control of the load during lifting operations. At wind speeds greater than 20 mph, the operator, rigger and lift supervisor must cease all crane operations, evaluate conditions and determine if the lift may proceed. Base the determination to proceed or not on wind calculations per the manufacturer and a reduction in LHE rated capacity if applicable. Include this maximum wind speed determination as part of the activity hazard analysis plan for that operation.

3.4.3 Machinery and Mechanized Equipment

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

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

3.4.4 Base Mounted Drum Hoists

a. Operation of base mounted drum hoists must comply with EM 385-1-1 and ASSE/SAFE A10.22.

b. When used on telecommunication towers, base mounted drum hoists must comply with TIA-1019, TIA-222, ASME B30.7, 29 CFR 1926.552, and 29 CFR 1926.553.

c. When used to hoist personnel, the AHA must include a written standard operating procedure. Operators must have a physical examination in accordance with EM 385-1-1 Section 16.B.05 and trained, at a minimum, in accordance with EM 385-1-1 Section 16.U and 16.T. The base mounted drum hoist must also comply with OSHA Instruction CPL 02-01-056 and ASME B30.23.

d. Material and personnel must not be hoisted simultaneously.

e. Personnel cage must be marked with the capacity (in number of persons) and load limit in pounds.

f. Construction equipment must not be used for hoisting material or personnel or with trolley/tag lines. Construction equipment may be used for towing and assisting with anchoring guy lines.

3.4.5 Use of Explosives

Explosives must not be used or brought to the project site without prior

written approval from the Contracting Officer. Such approval does not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

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

3.5 EXCAVATIONS

Soil classification must be performed by a competent person in accordance with 29 CFR 1926 and EM 385-1-1.

3.6 ELECTRICAL

Perform electrical work in accordance with EM 385-1-1, Appendix A, Sections 11 and 12.

3.6.1 Conduct of Electrical Work

As delineated in EM 385-1-1, electrical work is to be conducted in a de-energized state unless there is no alternative method for accomplishing the work. In those cases obtain an energized work permit from the Contracting Officer. The energized work permit application must be accompanied by the AHA and a summary of why the equipment/circuit needs to be worked energized. Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Attach temporary grounds in accordance with ASTM F855 and IEEE 1048. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator is allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method.

When working in energized substations, only qualified electrical workers are permitted to enter. When work requires work near energized circuits as defined by NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves and electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA. Ensure that each employee is familiar with and complies with these procedures and 29 CFR 1910.147.

3.6.2 Qualifications

Electrical work must be performed by QP personnel with verifiable credentials who are familiar with applicable code requirements. Verifiable credentials consist of State, National and Local Certifications or Licenses that a Master or Journeyman Electrician may hold, depending on work being performed, and must be identified in the appropriate AHA. Journeyman/Apprentice ratio must be in accordance with State, Local requirements applicable to where work is being performed.

3.6.3 Arc Flash

Conduct a hazard analysis/arc flash hazard analysis whenever work on or near energized parts greater than 50 volts is necessary, in accordance with NFPA 70E.

All personnel entering the identified arc flash protection boundary must be QPs and properly trained in NFPA 70E requirements and procedures. Unless permitted by NFPA 70E, no Unqualified Person is permitted to approach nearer than the Limited Approach Boundary of energized conductors and circuit parts. Training must be administered by an electrically qualified source and documented.

3.6.4 Grounding

Ground electrical circuits, equipment and enclosures in accordance with NFPA 70 and IEEE C2 to provide a permanent, continuous and effective path to ground unless otherwise noted by EM 385-1-1.

Check grounding circuits to ensure that the circuit between the ground and a grounded power conductor has a resistance low enough to permit sufficient current flow to allow the fuse or circuit breaker to interrupt the current.

3.6.5 Testing

Temporary electrical distribution systems and devices must be inspected, tested and found acceptable for Ground-Fault Circuit Interrupter (GFCI) protection, polarity, ground continuity, and ground resistance before initial use, before use after modification and at least monthly. Monthly inspections and tests must be maintained for each temporary electrical distribution system, and signed by the electrical CP or QP.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 45 00.15 10

RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE(RMS CM)

-- End of Section Table of Contents --

SECTION 01 45 00.15 10

RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE(RMS CM)

PART 1 GENERAL

This Section replaces Section 01 45 00.10 10 QUALITY CONTROL SYSTEM (QCS) in its entirety.

1.1 REFERENCES

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

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

1.2 MEASUREMENT AND PAYMENT

The work of this section is not measured for payment. The Contractor is responsible for the work of this section, without any direct compensation other than the payment received for contract items.

1.3 CONTRACT ADMINISTRATION

The Government will use the Resident Management System (RMS) to assist in its monitoring and administration of this contract. The Government accesses the system using the Government Mode of RMS (RMS GM) and the Contractor accesses the system using the Contractor Mode (RMS CM). The term RMS will be used in the remainder of this section for both RMS GM and RMS CM. The joint Government-Contractor use of RMS facilitates electronic exchange of information and overall management of the contract. The Contractor accesses RMS to record, maintain, input, track, and electronically share information with the Government throughout the contract period in the following areas:

Administration
Finances
Quality Control
Submittal Monitoring
Scheduling
Closeout
Import/Export of Data

1.3.1 Correspondence and Electronic Communications

For ease and speed of communications, exchange correspondence and other documents in electronic format to the maximum extent feasible. Some correspondence, including pay requests and payrolls, are also to be provided in paper format with original signatures. Paper documents will govern, in the event of discrepancy with the electronic version.

1.3.2 Other Factors

Other portions of this document have a direct relationship to the reporting accomplished through RMS. Particular attention is directed to Contract Clause, 52.236-15 "Schedules for Construction Contracts"; Contract Clause, 52.232-27 "Prompt Payment for Construction Contracts"; Contract Clause, 52.232-15 "Payments Under Fixed-Priced Construction Contracts"; Section 01 32 01.00 10 PROJECT SCHEDULE; Section 01 33 00 SUBMITTAL PROCEDURES; Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS; and Section 01 45 00.00 10 QUALITY CONTROL.

1.4 RMS SOFTWARE

RMS is a Windows-based program that can be run on a Windows-based PC meeting the requirements as specified in Paragraph: SYSTEM REQUIREMENTS. Download, install and be able to utilize the latest version of the RMS software within 7 calendar days of receipt of the Notice to Proceed. RMS software, user manuals, access and installation instructions, program updates and training information are available from the RMS website (http://rmsdocumentation.com). The Government and the Contractor will have different access authorities to the same contract database through RMS. The common database will be updated automatically each time a user finalizes an entry or change.

1.5 SYSTEM REQUIREMENTS

The following is the recommended system configuration to run the Contractor Mode RMS for full utilization of all features for all types and sizes of contracts. Smaller, less complicated, projects may not require the configuration levels described below. Required configuration also noted below.

Recommended RMS System Requirements	
Hardware	
Windows-based PC	1.7 GHz i3; AMD A6 3650 GHz or higher processor (REQUIRED)
RAM	8 GB
Hard drive disk	100 GB space for sole use by RMS system
Monitor	Screen resolution 1366 x 768
Mouse or other pointing device	
Windows compatible printer	Laser printer must have 4 MB+ of RAM
Connection to the Internet	minimum 4 Mbs per user
Software	
MS Windows	Windows 7 x 64 bit (RMS requires 64 bit O/S) or newer (REQUIRED)

Recommended RMS System Requirements	
Word Processing software	Viewer for MS Word 2013, MS Excel 2013 or newer (REQUIRED)
E-mail	MAPI compatible (REQUIRED)
Virus protection software	Regularly upgraded with all issued Manufacturer's updates and is able to detect most zero day viruses (REQUIRED)

1.6 CONTRACT DATABASE - GOVERNMENT

The Government will enter the basic contract award data in RMS prior to granting the Contractor access. The Government entries into RMS will generally be related to submittal reviews, correspondence status, and Quality Assurance(QA)comments, as well as other miscellaneous administrative information.

1.7 CONTRACT DATABASE - CONTRACTOR

Contractor entries into RMS establish, maintain, and update data throughout the duration of the contract. Contractor entries generally include prime and subcontractor information, daily reports, submittals, RFI's, schedule updates and payment requests. RMS includes the ability to import attachments and export reports in many of the modules, including submittals. The contractor responsibilities for entries in RMS typically include the following items:

1.7.1 Administration

1.7.1.1 Contractor Information

Enter all current Contractor administrative data and information into RMS within 7 calendar days of receiving access to the contract in RMS. This includes, but is not limited to, Contractor's name, address, telephone numbers, management staff, and other required items.

1.7.1.2 Subcontractor Information

Enter all missing subcontractor administrative data and information into RMS CM within 7 calendar days of receiving access to the contract in RMS or within 7 calendar days of the signing of the subcontractor agreement for agreements signed at a later date. This includes name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor is listed separately for each trade to be performed.

1.7.1.3 Correspondence

Identify all Contractor correspondence to the Government with a serial number. Prefix correspondence initiated by the Contractor's site office with "S". Prefix letters initiated by the Contractor's home (main) office with "H". Letters are numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C" or "RFP".

1.7.1.4 Equipment

Enter and maintain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.7.1.5 Reports

Track the status of the project utilizing the reports available in RMS. The value of these reports is reflective of the quality of the data input. These reports include the Progress Payment Request worksheet, Quality Control (QC) comments, Submittal Register Status, and Three-Phase Control worksheets.

1.7.1.6 Request For Information (RFI)

Create and track all Requests For Information (RFI) in the RMS Administration Module for Government review and response.

1.7.2 Finances

1.7.2.1 Pay Activity Data

Develop and enter a list of pay activities in conjunction with the project schedule. The sum of pay activities equals the total contract amount, including modifications. Each pay activity must be assigned to a Contract Line Item Number (CLIN). The sum of the activities assigned to a CLIN equals the amount of each CLIN.

1.7.2.2 Payment Requests

Prepare all progress payment requests using RMS. Update the work completed under the contract at least monthly, measured as percent or as specific quantities. After the update, generate a payment request and prompt payment certification using RMS. Submit the signed prompt payment certification and payment request as well as supporting data either electronically or by hard copy. Unless waived by the Contracting Officer, a signed paper copy of the approved payment certification and request is also required and will govern in the event of discrepancy with the electronic version.

1.7.3 Quality Control (QC)

Enter and track implementation of the 3-phase QC Control System, QC testing, transferred and installed property and warranties in RMS. Prepare daily reports, identify and track deficiencies, document progress of work, and support other Contractor QC requirements in RMS. Maintain all data on a daily basis. Insure that RMS reflects all quality control methods, tests and actions contained within the Contractor Quality Control (CQC) Plan and Government review comments of same within 7 calendar days of Government acceptance of the CQC Plan.

1.7.3.1 Quality Control (QC) Reports

The Contractor's Quality Control (QC) Daily Report in RMS is the official report. The Contractor can use other supplemental formats to record QC data, but information from any supplemental formats are to be consolidated and entered into the RMS QC Daily Report. Any supplemental information may be entered into RMS as an attachment to the report. QC Daily Reports

must be finalized and signed in RMS within 24 hours after the date covered by the report. Provide the Government a printed signed copy of the QC Daily Report, unless waived by the Contracting Officer.

1.7.3.2 Deficiency Tracking.

Use the QC Daily Report Module to enter and track deficiencies. Deficiencies identified and entered into RMS by the Contractor or the Government will be sequentially numbered with a QC or QA prefix for tracking purposes. Enter each deficiency into RMS the same day that the deficiency is identified. Monitor, track and resolve all QC and QA entered deficiencies. A deficiency is not considered to be corrected until the Government indicates concurrence in RMS.

1.7.3.3 Three-Phase Control Meetings

Maintain scheduled and actual dates and times of preparatory and initial control meetings in RMS. Worksheets for the three-phase control meetings are generated within RMS.

1.7.3.4 Labor and Equipment Hours

Enter labor and equipment exposure hours on a daily basis. Roll up the labor and equipment exposure data into a monthly exposure report.

1.7.3.5 Accident/Safety Reporting

Both the Contractor and the Government enter safety related comments in RMS as a deficiency. The Contractor will monitor, track and show resolution for safety issues in the QC Daily Report area of the RMS QC Module. In addition, follow all reporting requirements for accidents and incidents as required in EM 385-1-1, Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS and as required by any other applicable Federal, State or local agencies.

1.7.3.6 Definable Features of Work

Enter each feature of work, as defined in the approved CQC Plan, into the RMS QC Module. A feature of work may be associated with a single or multiple pay activities, however a pay activity is only to be linked to a single feature of work.

1.7.3.7 Activity Hazard Analysis

Import activity hazard analysis electronic document files into the RMS QC Module utilizing the document package manager.

1.7.4 Submittal Management

Enter all current submittal register data and information into RMS within 7 calendar days of receiving access to the contract in RMS. The information shown on the submittal register following the specification section 01 33 00 SUBMITTAL PROCEDURES will already be entered into the RMS database when access is granted. Group electronic submittal documents into transmittal packages to send to the Government, except very large electronic files, samples, spare parts, mock ups, color boards, or where hard copies are specifically required. Track transmittals and update the submittal register in RMS on a daily basis throughout the duration of the contract. Submit hard copies of all submittals unless waived by the

Contracting Officer.

1.7.5 Schedule

Enter and update the contract project schedule in RMS by either manually entering all schedule data or by importing the Standard Data Exchange Format (SDEF) file, based on the requirements in Section 01 32 01.00 13 PROJECT SCHEDULE.

1.7.6 Closeout

Closeout documents, processes and forms are managed and tracked in RMS by both the Contractor and the Government. Ensure that all closeout documents are entered, completed and documented within RMS.

1.8 IMPLEMENTATION

Use of RMS as described in the preceding paragraphs is mandatory. Ensure that sufficient resources are available to maintain contract data within the RMS system. RMS is an integral part of the Contractor's required management of quality control.

1.9 NOTIFICATION OF NONCOMPLIANCE

Take corrective action within 7 calendar days after receipt of notice of RMS non-compliance by the Contracting Officer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 57 20.00 10

ENVIRONMENTAL PROTECTION

-- End of Section Table of Contents --

SECTION 01 57 20.00 10

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

This section supplements the Base BOA Division 01 of the same name and title.

1.1 REFERENCES

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

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

40 CFR 273	Standards For Universal Waste Management
40 CFR 60	Standards of Performance for New Stationary Sources
40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 63	National Emission Standards for Hazardous Air Pollutants for Source Categories
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
40 CFR 763	Asbestos

1.2 RELATED REGULATIONS

Comply with the following regulations:.

40 CFR 110-149 Clean Water Act
40 CFR 1500-1508 NEPA Regulations
33 CFR 230 Civil Works/Federal Projects
33 CFR 325 Appendix B Regulatory Permits

1.2.1 Universal Waste

The universal waste regulations streamline collection requirements for certain hazardous wastes in the following categories: batteries, pesticides, mercury-containing equipment (for example, thermostats), and lamps (for example, fluorescent bulbs). The rule is designed to reduce hazardous waste in the municipal solid waste (MSW) stream by making it easier for universal waste handlers to collect these items and send them for recycling or proper disposal. These regulations can be found at 40 CFR 273.

1.3 CLEAN AIR ACT COMPLIANCE

1.3.1 Pollution Generating Equipment

Identify air pollution generating equipment or processes that may require federal, state, or local permits under the Clean Air Act. Determine requirements based on any current installation permits and the impacts of the project. Provide a list of all fixed or mobile equipment, machinery or operations that could generate air emissions during the project to the Installation Environmental Office (Air Program Manager).

1.3.2 Stationary Internal Combustion Engines

Identify portable and stationary internal combustion engines that will be supplied, used or serviced. Comply with 40 CFR 60 Subpart IIII, 40 CFR 60 Subpart JJJJ, 40 CFR 63 Subpart ZZZZ, and local regulations as applicable. At minimum, include the make, model, serial number, manufacture date, size (engine brake horsepower), and EPA emission certification status of each engine. Maintain applicable records and log hours of operation and fuel use. Logs must include reasons for operation and delineate between emergency and non-emergency operation.

1.3.3 Refrigerants

Identify management practices to ensure that heating, ventilation, and air conditioning (HVAC) work involving refrigerants complies with 40 CFR 82 requirements. Technicians must be certified, maintain copies of certification on site, use certified equipment and log work that requires the addition or removal of refrigerant. Any refrigerant reclaimed is the property of the Government, coordinate with the Installation Environmental Office to determine the appropriate turn in location.

1.3.4 Air Pollution-engineering Processes

Identify planned air pollution-generating processes and management control measures (including, but not limited to, spray painting, abrasive blasting, demolition, material handling, fugitive dust, and fugitive emissions). Log hours of operations and track quantities of materials used.

1.3.5 Compliant Materials

Provide the Government a list of and SDSs for all hazardous materials proposed for use on site. Materials must be compliant with all Clean Air Act regulations for emissions including solvent and volatile organic compound contents, and applicable National Emission Standards for Hazardous Air Pollutants requirements. The Government may alter or limit use of specific materials as needed to meet installation permit requirements for emissions.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 CONTROL AND MANAGEMENT OF ASBESTOS-CONTAINING MATERIAL (ACM)

Manage and dispose of asbestos- containing waste in accordance with

40 CFR 61 and 40 CFR 763. Refer to UFGS 02 82 13.00 10 ASBESTOS ABATEMENT. Manifest asbestos-containing waste and provide the manifest to the Contracting Officer. Notifications to the state and Installation Air Program Manager are required before starting any asbestos work.

3.2 CONTROL AND MANAGEMENT OF POLYCHLORINATED BIPHENYLS (PCBS)

Manage and dispose of PCB-contaminated waste in accordance with 40 CFR 761 and UFGS 02 84 33 REMOVAL AND DISPOSAL OF POLYCHLORINATED BIPHENYLS (PCBS).

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS

2.2.14 GROUP-OPERATED LOAD INTERRUPTER SWITCHES
2.2.14.1 Manually Operated Type (Switch Handle Operated)
2.2.14.2 Remotely Operated Type (Stored-Energy Actuator)
2.2.15 RECLOSER
2.2.16 SECTIONALIZER
2.2.17 METERING EQUIPMENT
2.2.17.1 Potential Transformers
2.2.17.2 Current Transformers
2.2.17.3 Watthour Meter
2.2.17.4 Meter Test Block
2.2.17.5 Metering Enclosure
2.2.18 CAPACITORS
2.2.19 VOLTAGE REGULATOR
2.2.19.1 Bypass And Isolation Switches
2.2.19.2 Miscellaneous
2.2.20 ELECTRICAL TAPES
2.2.21 CAULKING COMPOUND
2.3 SUPPLY STATION AND SUBSTATION MATERIALS AND EQUIPMENT
2.3.1 Nameplates
2.3.1.1 General
2.3.1.2 Liquid-Filled Transformer Nameplates
2.3.2 Corrosion Protection
2.3.2.1 Aluminum Materials
2.3.2.2 Ferrous Metal Materials
2.3.2.2.1 Hardware
2.3.2.2.2 Equipment
2.3.3 Station Miscellaneous Equipment
2.3.3.1 Conductors
2.3.3.1.1 Suspension Insulators
2.3.3.1.2 Apparatus Post Insulators
2.3.4 Incoming Switching/Circuit Interrupting Equipment
2.3.4.1 Metal-Enclosed Interrupter Switchgear
2.3.4.1.1 Ratings
2.3.4.1.2 Operating Mechanism Controls and Devices
2.3.4.1.3 Sulfur Hexafluoride (SF6) Interrupter Switchgear
2.3.4.1.4 Vacuum Circuit Interrupter Switchgear
2.3.4.1.5 Specific Unit Requirements
2.3.4.2 Devices and Accessories for Switching/Interrupting Equipment
2.3.4.2.1 Incoming Line
2.3.4.2.2 Line Tie
2.3.4.2.3 Instrument and Relay Cabinet
2.3.4.3 Power Fuse Disconnecting Units
2.3.4.3.1 Power Fuse Disconnecting Unit Ratings
2.3.4.3.2 Construction
2.3.4.3.3 E-Rated, Current-Limiting Power Fuses
2.3.4.3.4 C-Rated, Current-Limiting Power Fuses
2.3.4.3.5 Additional Requirements
2.3.4.4 Line Switches
2.3.4.4.1 Ratings
2.3.4.4.2 Standard Devices and Accessories
2.3.4.4.3 Stick (Hook) Operated Line Switches
2.3.4.4.4 Group-Operated Line Switches
2.3.4.4.4.1 Air-Insulated
2.3.4.4.4.2 SF6-Insulated
2.3.4.4.4.3 Load Interrupter Type, Air-Insulated
2.3.4.4.4.4 Disconnecting Type, Air-Insulated
2.3.4.4.4.5 Manually-Operated Type, Air-Insulated
2.3.4.4.5 Switch Operators

-- End of Section Table of Contents --

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

This Section replaces 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS and 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS in their entirety.

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.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS ANSI O5.1	(2008) Wood Poles -- Specifications & Dimensions

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(2008) Electric Meters Code for Electricity Metering
ANSI C135.14	(1979) Staples with Rolled or Slash Points for Overhead Line Construction

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C25	(2003) Sawn Crossarms - Preservative Treatment by Pressure Processes

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2015) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A475	(2003; R 2014) Standard Specification for Zinc-Coated Steel Wire Strand
ASTM A575	(1996; E 2013; R 2013) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

ASTM A576	(1990b; R 2012) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM B1	(2013) Standard Specification for Hard-Drawn Copper Wire
ASTM B2	(2013) Standard Specification for Medium-Hard-Drawn Copper Wire
ASTM B230/B230M	(2007; R 2016) Standard Specification for Aluminum 1350-H19 Wire for Electrical Purposes
ASTM B231/B231M	(2012) Standard Specification for Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B232/B232M	(2011) Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR)
ASTM B3	(2013) Standard Specification for Soft or Annealed Copper Wire
ASTM B398/B398M	(2015) Standard Specification for Aluminum-Alloy 6201-T81 Wire for Electrical Purposes
ASTM B399/B399M	(2004; R 2015) Standard Specification for Concentric-Lay-Stranded Aluminum-Alloy 6201-T81 Conductors
ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D117	(2010) Standard Guide for Sampling, Test Methods, Specifications and Guide for Electrical Insulating Oils of Petroleum Origin
ASTM D3487	(2016) Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus
ASTM D877/D877M	(2013) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D92	(2012a) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM D97	(2017a) Standard Test Method for 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 18	(2012) Standard for Shunt Power Capacitors
IEEE C135.1	(1999) Standard for Zinc-Coated Steel Bolts and Nuts for Overhead Line Construction
IEEE C135.2	(1999) Threaded Zinc-Coated Ferrous Strand-Eye Anchor Rods and Nuts for Overhead Line Construction
IEEE C135.22	(1988) Standard for Zinc-Coated Ferrous Pole-Top Insulator Pins with Lead Threads for Overhead Line Construction
IEEE C135.30	(1988) Standard for Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
IEEE C2	(2017; Errata 1 2017) National Electrical Safety Code
IEEE C37.32	(2002) High-Voltage Switches, Bus Supports, and Accessories - Schedules of Preferred Ratings, Construction Guidelines and Specifications
IEEE C37.41	(2016) Standard Design Tests for High-Voltage (>1000 V) Fuses and Accessories
IEEE C37.63	(2013) Standard Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizers for AC Systems
IEEE C57.12.20	(2011) Standard for Overhead Type Distribution Transformers, 500 KVA and Smaller: High Voltage 34 500 Volts and Below: Low Voltage, 7970/13,800 Y Volts and Below
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
IEEE C57.13	(2016) Requirements for Instrument Transformers
IEEE C57.15	(2009) Standard Requirements, Terminology, and Test Code for Step-Voltage Regulators

IEEE C62.11	(2012) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

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

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.7	(2014) Requirements for Watthour Meter Sockets
ANSI C29.2	(2012) American National Standard for Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type
ANSI C29.3	(1986; R 2012) American National Standard for Wet Process Porcelain Insulators - Spool Type
ANSI C29.4	(1989; R 2012) Standard for Wet-Process Porcelain Insulators - Strain Type
ANSI C29.5	(1984; R 2002) Wet-Process Porcelain Insulators (Low and Medium Voltage Pin Type)
ANSI/NEMA WC 71/ICEA S-96-659	(2014) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy
NEMA 250	(2014) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA C135.4	(1987) Zinc-Coated Ferrous Eyebolts and Nuts for Overhead Line Construction
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA WC 70	(2009) Power Cable Rated 2000 V or Less for the Distribution of Electrical Energy--S95-658
NEMA/ANSI C12.10	(2011) Physical Aspects of Watthour Meters - Safety Standards
NEMA/ANSI C29.7	(1996; 2002) American National Standard for Wet Process Porcelain Insulators - High-Voltage Line Post Type

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2)

National Electrical Code

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

OECD Test 203	(1992) Fish Acute Toxicity Test

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 202-1	(2004) List of Materials Acceptable for Use on Systems of RUS Electrification Borrowers
RUS Bull 1728H-701	(1993) Wood Crossarms (Solid and Laminated), Transmission Timbers and Pole Keys
RUS Bull 345-67	(1998) REA Specification for Filled Telephone Cables, PE-39

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

UNDERWRITERS LABORATORIES (UL)

UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL 486A-486B	(2013; Reprint Jan 2016) Wire Connectors
UL 510	(2017) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 6	(2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel

1.2 DEFINITIONS

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

1.3 QUALITY ASSURANCE

1.3.1 Regulatory Requirements

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

and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.3.2 Standard Products

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

1.3.2.1 Alternative Qualifications

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

1.4 WARRANTY

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

1.5 MANUFACTURER'S NAMEPLATE

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

1.6 WARNING SIGNS

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

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers and pad-mounted SF6 switches, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of

nominal 3 inch high white letters on a red and black field.

1.7 ELECTRICAL REQUIREMENTS

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

PART 2 PRODUCTS

2.1 SALVAGE MATERIALS

Materials and equipment may be salvaged from the existing electrical distribution and transmission system if deemed to be reusable and reliable by PREPA.

2.2 TRANSMISSION AND DISTRIBUTION MATERIALS AND EQUIPMENT

Provide materials and equipment in accordance with PREPA standards. If the PREPA standards are not available or do not address a particular element, use the specifications in this Section.

Consider materials specified herein which are identical to materials listed in RUS 202-1 as conforming to requirements. Equipment and component items, not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes. Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.2.1 Poles

2.2.1.1 Wood Poles

Wood poles machine trimmed by turning, conforming to ATIS ANSI O5.1 and RUS Bull 345-67. Gain, bore and roof poles before treatment. Should additional gains be required subsequent to treatment, metal gain plates shall be provided. Pressure treat poles. The quality of each pole shall be ensured with "WQC" (wood quality control) brand on each piece, or by an approved inspection agency report.

2.2.1.2 Steel Poles

Steel poles shall be designed to withstand the loads specified in IEEE C2 multiplied by the appropriate overload capacity factors, shall be hot-dip galvanized in accordance with ASTM A123/A123M and shall not be painted. Poles shall have tapered tubular members, either round in cross-section or polygonal, and comply with strength calculations performed by a registered professional engineer. Pole shafts shall be one piece. Poles shall be welded construction with no bolts, rivets, or other means of fastening except as specifically approved. Pole markings shall be approximately 3 to 4 feet above grade and shall include manufacturer, year of manufacture, top and bottom diameters, length, and a loading tree. Attachment requirements shall be provided, including grounding provisions. Climbing facilities are not required. Bases shall be of the anchor-bolt-mounted type.

2.2.1.3 Concrete Poles

Concrete poles shall be designed to withstand the loads specified in

IEEE C2 multiplied by the appropriate overload capacity factors. Poles shall be reinforced or prestressed, either cast or spun. Spun poles shall be manufactured by a centrifugal spinning process with concrete pumped into a polished round tapered metal mold. Concrete for spun poles shall have a compressive strength of at least 5000 psi at 28 days; steel wire shall have an ultimate tensile strength of at least 120,000 psi; and reinforcing bars shall have an ultimate tensile strength of at least 40,000 psi. After the high speed spinning action is completed, a spun pole shall be cured by a suitable wet steam process. Spun poles shall have a water absorption of not greater than three percent to eliminate cracking and to prevent erosion. Concrete poles shall have hollow shafts. Poles shall have a hard, smooth, nonporous surface that is resistant to soil acids, road salts, and attacks of water and frost. Poles shall not be installed for at least 15 days after manufacture. Fittings and brackets that conform to the concrete pole design shall be provided.

2.2.2 CROSSARMS AND BRACKETS

2.2.2.1 Wood Crossarms

Conform to RUS Bull 1728H-701. Pressure treat crossarms with pentachlorophenol, chromated copper arsenate (CCA), or ammoniacal copper arsenate (ACA). Treatment shall conform to AWPA C25. Crossarms shall be solid wood, distribution type, and a 1/4 inch 45 degree chamfer on all top edges. Cross-sectional area minimum dimensions shall be 4-1/4 inches in height by 3-1/4 inches in depth in accordance with IEEE C2 for Grade B construction. Crossarms shall be 8 feet in length, except that 10 foot crossarms shall be used for crossarm-mounted banked single-phase transformers. Crossarms shall be machined, chamfered, trimmed, and bored for stud and bolt holes before pressure treatment. Factory drilling shall be provided for pole and brace mounting, for four pin or four vertical line-post insulators, and for four suspension insulators, except where otherwise indicated or required. Drilling shall provide required climbing space and wire clearances. Crossarms shall be straight and free of twists to within 1/10 inch per foot of length. Bend or twist shall be in one direction only.

2.2.2.2 Crossarm Braces

Provide flat steel or steel angle. Provide braces with 38 inch span for 8 foot crossarms and 60 inch span for 10 foot crossarms.

2.2.2.3 Armless Construction

Brackets shall be attached to poles with a minimum of two bolts. Brackets may be either provided integrally as part of an insulator or attached to an insulator with a suitable stud. Bracket mounting surface shall be suitable for the shape of the pole. Brackets for wood poles shall have wood gripping members. Horizontal offset brackets shall have a 5-degree uplift angle. Pole top brackets shall conform to IEEE C135.22, except for modifications necessary to provide support for a line-post insulator. Brackets shall provide a strength exceeding that of the required insulator strength, but in no case less than a 2800 pound cantilever strength.

2.2.3 HARDWARE

Hardware shall be hot-dip galvanized in accordance with ASTM A153/A153M and ASTM A123/A123M.

Zinc-coated hardware shall comply with IEEE C135.1, IEEE C135.2, NEMA C135.4, ANSI C135.14 IEEE C135.22. Steel hardware shall comply with ASTM A575 and ASTM A576. Washers shall be installed under boltheads and nuts on wood surfaces and elsewhere as required. Washers used on through-bolts and double-arming bolts shall be approximately 2-1/4 inches square and 3/16 inch thick. The diameter of holes in washers shall be the correct standard size for the bolt on which a washer is used. Washers for use under heads of carriage-bolts shall be of the proper size to fit over square shanks of bolts. Eye bolts, bolt eyes, eyenuts, strain-load plates, lag screws, guy clamps, fasteners, hooks, shims, and clevises shall be used wherever required to support and to protect poles, brackets, crossarms, guy wires, and insulators.

2.2.4 INSULATORS

Provide wet-process porcelain insulators which are radio interference free.

a. Line post type insulators: NEMA/ANSI C29.7.

b. Suspension insulators: ANSI C29.2

c. Spool insulators: ANSI C29.3.

d. Guy strain insulators: ANSI C29.4, except provide fiberglass type when used with underground terminal or when other interference problems exist.

e. Pin insulators: ANSI C29.5.

2.2.5 OVERHEAD CONDUCTORS, CONNECTORS AND SPLICES

Provide conductors of the same material that was in the existing system. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486A-486B shall be used.

2.2.5.1 Solid Copper

ASTM B1, ASTM B2, and ASTM B3, hard-drawn, medium-hard-drawn, and soft-drawn, respectively. ASTM B8, stranded.

2.2.5.2 Aluminum (AAC)

ASTM B230/B230M and ASTM B231/B231M.

2.2.5.3 Aluminum Alloy (AAAC)

ASTM B398/B398M or ASTM B399/B399M.

2.2.5.4 Aluminum Conductor Steel Reinforced (ACSR)

ASTM B232/B232M, aluminum.

2.2.5.5 Connectors and Splices

Connectors and splices shall be of copper alloys for copper conductors, aluminum alloys for aluminum-composition conductors, and a type designed to minimize galvanic corrosion for copper to aluminum-composition conductors. Aluminum-composition, aluminum-composition to copper, and

copper-to-copper shall comply with UL 486A-486B.

2.2.6 NEUTRAL-SUPPORTED SECONDARY AND SERVICE DROP CABLES

Service and Secondary cables shall be aluminum or copper, triplex or quadruplex with cross-linked polyethylene insulation on the phase conductors. Neutral shall be bare ACSR, aluminum alloy, or hard drawn copper and shall be the same size as the phase conductors unless otherwise indicated. Cables shall conform to NEMA WC 70 and ANSI/NEMA WC 71/ICEA S-96-659 for cross-linked polyethylene insulation.

2.2.7 GUY STRAND

ASTM A475, Class A or B, galvanized strand steel cable or Class 30 copper-clad steel. Provide guy terminations designed for use with the particular strand and developing at least the ultimate breaking strength of the strand.

2.2.8 ROUND GUY MARKERS

Vinyl or PVC material, 8 feet long and shatter resistant.

2.2.8.1 Guy Attachment

Thimble eye guy attachment.

2.2.9 ANCHORS AND ANCHOR RODS

Anchors shall present holding area indicated on drawings as a minimum. Anchor rods shall be triple thimble-eye. Anchors and anchor rods shall be hot dip galvanized.

2.2.10 GROUNDING AND BONDING

2.2.10.1 Driven Ground Rods

Provide copper-clad steel ground rods conforming to UL 467, zinc-coated steel ground rods conforming to IEEE C135.30, or solid stainless steel ground rods not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used for rods 20 feet or longer.

2.2.10.2 Grounding Conductors

ASTM B3. Provide soft drawn copper wire ground conductors a minimum No. 4 AWG. Ground wire protectors shall be PVC.

2.2.10.3 Grounding Connections

UL 467. Exothermic weld or compression connector.

2.2.11 SURGE ARRESTERS

IEEE C62.11, metal oxide, polymeric-housed, surge arresters..

2.2.12 CONDUIT RISERS AND CONDUCTORS

The riser shield shall be PVC containing a PVC back plate and PVC extension shield or a rigid galvanized steel conduit, conforming to UL 6..

2.2.13 TRANSFORMER (OVERHEAD-TYPE DISTRIBUTION)

a. IEEE C57.12.20.

b. Single phase, self-cooled, 65 degrees C. continuous temperature rise, two winding, 60 Hertz.

c. Insulating liquid:

Mineral oil: ASTM D3487, Type II, tested in accordance with ASTM D117. Provide identification of transformer as "non-PCB" and "Type II mineral oil" on the nameplate.

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/D877M. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid on the nameplate.

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

(1) Pour point: ASTM D97, less than -15 degrees 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.

d. Taps:

(1) Provide four 2 1/2 percent full capacity taps, 2 above and 2 below rated primary voltage. Tap changer shall have external handle.

e. Externally operated Series-Multiple Voltage-Changing Switch.

f. Corrosion Protection:

Transformer tanks and covers shall be corrosion resistant and shall be fabricated of stainless steel conforming to ASTM A167, Type 304 or 304L. Paint coating system shall comply with IEEE C57.12.28 regardless of tank and cover material. Finish coat shall be light gray, ANSI color No. 70.

g. Show transformer kVA capacity using 2 1/2 inch Arabic numerals placed near the low-voltage bushings.

2.2.13.1 Specified Transformer Losses

No-load losses (NLL) in watts at 20 degrees C, and load losses (LL) in watts at 85 degrees C

2.2.14 GROUP-OPERATED LOAD INTERRUPTER SWITCHES

2.2.14.1 Manually Operated Type (Switch Handle Operated)

Manually operated (switch handle operated) load interrupter switches shall

comply with IEEE C37.32 and shall be of the outdoor, manually-operated, three-pole, single-throw type with either tilting or rotating insulators. Switches shall be equipped with interrupters capable of interrupting currents equal to the switch's continuous current rating. Each switch shall be preassembled for the indicated configuration and mounting. Moving contacts shall be of the high-pressure, limited-area type, designed to ensure continuous surface contact. Switches shall be fused or non-fused. Switches shall be complete with necessary operating mechanisms, handles, and other items required for manual operation from the ground. Switch operating handles shall be located approximately 3 feet 6 inches above final grade. Insulation of switch operating mechanisms shall include both insulated interphase rod sections and insulated vertical shafts. Each handle shall be provided with a padlock arranged to lock the switch in both the open and the closed position.

2.2.14.2 Remotely Operated Type (Stored-Energy Actuator)

Remotely-operated, air-insulated or SF6 insulated load interrupter switches shall be rated in accordance with and comply with the requirements of IEEE C37.32 and shall be of the outdoor, three-pole, pole-mounted or crossarm-mounted type. Interrupter devices shall be air-insulated or SF6-insulated, puffer-type switches capable of interrupting currents equal to the switch continuous current ratings indicated. Switches shall utilize an electric motor-charged, stored-energy (spring-driven) operator to simultaneously trip all phases. A switch-control unit shall be provided for push-button operation from the ground or for push-button operation from the ground and remote switch actuation via telemetry. The switch-control unit shall be pad-lockable, tamper-resistant, in a NEMA ICS 6 enclosure, which is connected to the switch actuator by a shielded control cable. Control power for closing and tripping shall be provided by a battery mounted in the control unit enclosure. The switch control unit shall be provided with a separate 120 volt ac circuit for the battery powered. Power for charging the operator mechanism may be 120 volt ac or battery powered. The switch control unit shall be configured for supervisory, control, and data acquisition (SCADA) function, including local and remote operation. Voltage and current sensors shall be provided, one set for each phase, for monitoring of both normal and fault conditions. Switches shall be provided with visual indication of open switch contact for clearance and isolation purposes. Switch mechanisms shall be provided with provisions for grounding of nonenergized metal parts. The switch control unit shall be provided with a switch operations.

2.2.15 RECLOSER

IEC 62271-111. Recloser controller shall be electronically or hydraulically operated and utilize oil or vacuum operating medium.

2.2.16 SECTIONALIZER

IEEE C37.63.

2.2.17 METERING EQUIPMENT

Pole mounted metering equipment shall include current transformers, potential transformers, watthour meter, metering enclosure, wire, conduit and fittings.

2.2.17.1 Potential Transformers

Potential transformers shall be rated for outdoor service fitted for crossarm mounting and secondary connection box for conduit connection. Transformers shall conform to the requirements of IEEE C57.13.

2.2.17.2 Current Transformers

Current transformers shall be rated for outdoor service with crossarm mounting and secondary connection box for conduit connection. Transformers shall conform to requirements of IEEE C57.13.

2.2.17.3 Watthour Meter

Provide meter with provisions for future pulse initiation.

a. Meters: NEMA/ANSI C12.10 and ANSI C12.1; when providing meter with electronic time-of-use register.

b. Demand register:

(1) Solid state type.

(2) Meter reading multiplier:

(a) Indicate multiplier on the meter face.

(b) Provide multiplier in even hundreds.

c. Mounting:

(1) Provide meter with either matching socket per ANSI C12.7 with manual or automatic current short-circulating device; or "A" base type mounting.

2.2.17.4 Meter Test Block

Provide meter test block with T or 10 pole group of open knife type switches designed for the isolation of metering devices at meter location by opening each circuit individually. Current switches shall short circuit current supply before opening meter circuit. Switch handles of potential switches shall be black. Switch handles of current switches shall be red.

]2.2.17.5 Metering Enclosure

Metering enclosure shall be of galvanized steel, weatherproof construction with pole mounting bracket, and 3/4 inch exterior plywood, full size backboard and hinged door arranged for padlocking in closed position. Internal space shall be adequate to house equipment and wiring but not smaller than 20 by 30 by 11 inches deep. Paint metal manufacturer's standard finish.

2.2.18 CAPACITORS

Capacitor equipment shall comply with IEEE 18 and shall be of the three-phase, grounded-wye, outdoor type rated for continuous operation and automatically switched. Equipment shall be suitable for mounting on a single pole. Polychlorinated biphenyl and tetrachloroethylene

(perchloroethylene) shall not be used as the dielectric. Equipment shall be rated for the system voltage. Necessary transformers shall be provided for sensing circuit variations and for low-voltage control. Oil-immersed switches shall be provided for automatic switching of capacitors, and shall be electrically separate from ungrounded capacitor enclosures and metal frames. Installations shall include one primary fuse cutout and one surge arrester for each ungrounded phase conductor. Fuse link ratings shall be in accordance with the manufacturer's recommendations. Capacitor equipment, except for low-voltage control and primary fuse cutouts, shall be subassembled and coordinated by one manufacturer. Units, including metal pole-mounting supports and hardware, shall be shipped in complete sections ready for connection at the site. Low-voltage equipment shall be socket or cabinet type, mounted on the pole approximately 4 feet above grade, shall be connected with the necessary wiring in conduit to capacitor equipment, and shall be provided with secondary arrester protection against switching surges when recommended by the manufacturer.

2.2.19 VOLTAGE REGULATOR

Voltage regulators shall comply with IEEE C57.15 and shall be of the outdoor, self-cooled, 55/65 degrees C temperature rise, single-phase type. Windings and the load-tap-changing mechanism shall be mineral-oil-immersed. When operating under load, a regulator shall provide plus and minus 10 percent automatic voltage regulation in approximately 5/8 percent steps, with 16 steps above and 16 steps below rated voltage. Automatic control equipment shall provide Class 1 accuracy. Bypass surge arresters shall be suitable for the system and for the associated regulator voltage. Surge arresters shall be mounted next to each incoming line bushing on a regulator tank-mounted bracket and connected to a surge arrester ground pad-mounted on the regulator tank].

2.2.19.1 Bypass And Isolation Switches

Switches shall be of the outdoor, stickhook-operated, single-pole, single-throw, vertical-break type suitable for the indicated mounting. Switches shall be of a type designed to provide bypass of a single-phase regulator circuit by an integral sequence which always occurs when each switch is opened or closed. Each opening sequence shall initially bypass the single-phase regulator circuit, then open the input and output circuits, and finally interrupt the exciting current. Opening any single-phase regulator circuit shall not be possible until after the bypass circuit is closed. Ratings at 60 Hz shall be in accordance with IEEE C37.41.

2.2.19.2 Miscellaneous

Standard accessories and components in accordance with IEEE C57.15shall be provided. Single-phase units shall be provided with additional components and accessories required by IEEE C57.15 for three-phase units.

2.2.20 ELECTRICAL TAPES

Tapes shall be UL listed for electrical insulation and other purposes in wire and cable splices. Terminations, repairs and miscellaneous purposes, electrical tapes shall comply with UL 510.

2.2.21 CAULKING COMPOUND

Compound for sealing of conduit risers shall be of a puttylike consistency

workable with hands at temperatures as low as 35 degrees F, shall not slump at a temperature of 300 degrees F, and shall not harden materially when exposed to air. Compound shall readily caulking or adhere to clean surfaces of the materials with which it is designed to be used. Compound shall have no injurious effects upon the workmen or upon the materials.

2.3 SUPPLY STATION AND SUBSTATION MATERIALS AND EQUIPMENT

Provide materials and equipment in accordance with PREPA standards. If the PREPA standards are not available or do not address a particular element, use the specifications in this Section.

Provide materials and equipment which are the standard product of a manufacturer regularly engaged in the manufacture of the product and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to request for proposal.

a. Submit a complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item. Products shall conform to the following requirements. Items of the same classification shall be identical including equipment, assemblies, parts, and components. Products for aerial construction shall conform to IEEE C2 for heavy loading districts, Grade B construction.

b. Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories, Inc., (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), submit proof that the items provided under this section of the specifications conform to such requirements.

c. The label of, or listing by, UL will be acceptable evidence that the items conform thereto. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable evidence that the item conforms thereto. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable evidence that the item conforms thereto.

d. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

2.3.1 Nameplates

2.3.1.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be

made of noncorrosive metal. As a minimum, provide nameplates for transformers, regulators, circuit breakers, capacitors, meters, switches, switchgear, and grounding resistors.

2.3.1.2 Liquid-Filled Transformer Nameplates

Provide power transformers, with Nameplate C information in accordance with IEEE C57.12.00, indicating the number of gallons and composition of liquid-dielectric, permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 50 ppm PCB content in accordance with paragraph MISCELLANEOUS Liquid Dielectrics. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 50 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.3.2 Corrosion Protection

2.3.2.1 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, use fittings conforming to UL 486A-486B.

2.3.2.2 Ferrous Metal Materials

2.3.2.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A153/A153M and ASTM A123/A123M.

2.3.2.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.3.3 Station Miscellaneous Equipment

2.3.3.1 Conductors

Conductors shall be aluminum-conductor-steel-reinforced (ACSR), or copper, or high-strength aluminum alloy, and shall comply with IEEE 525. Base span lengths on a limiting deflection of 1/150 for spans having two supports and 1/200 for spans having three supports, under maximum wind, ice, and short-circuit loadings, including suitable allowances for any taps. Where required, install larger or stronger bus to maintain specified deflections for the indicated span lengths. Other bus shapes for electrical conductors may be used if detail drawing submittals

indicate equivalent ampacity and strength. Short connections, consisting of bare stranded conductors of equivalent bus ampacity, may be used between incoming line conductors and buses or between buses and equipment. Copper flexible braid or aluminum strap expansion couplers, as required to match the bus material, shall be installed in bus runs where required to allow for expansion and contraction, and at all connections to transformer bushings.

2.3.3.1.1 Suspension Insulators

Provide suspension insulators for dead-end incoming line conductors. Utilize suspension insulator strings and string supports which provide a mechanical strength exceeding the ultimate strength of each dead-end conductor. Provide suspension insulators complying with NEMA C29.2B.

2.3.3.1.2 Apparatus Post Insulators

Apparatus post insulators shall be provided to support conductors, and their mechanical strength shall exceed the ultimate strength of the conductor supported and, where necessary, high-strength or ultra high-strength insulators shall be provided. Minimum ratings of apparatus post insulators shall be not less than required by ANSI C29.9.

2.3.4 Incoming Switching/Circuit Interrupting Equipment

Incoming line switching equipment shall be of the outdoor weatherproof type.

2.3.4.1 Metal-Enclosed Interrupter Switchgear

Metal-enclosed interrupter switchgear shall comply with IEEE C37.20.2 for metal clad switchgear, IEEE C37.20.3 for metal-enclosed switchgear, IEEE C37.32for load-interrupter switches, and shall be of the outdoor no-aisle type that meets or exceeds the requirements of applicable publications listed. Switch construction shall be of the manually-operated, "OPEN-CLOSED," air-insulated, load-interrupter type, or vacuum-insulated, load-interrupter type, or SF6-insulated, load-interrupter type, equipped with a stored energy operator for quick-make-quick-break to make operating speeds independent of manual switch operations. Where indicated, bus or lug connections to mount field-installed, slip-on, medium-voltage cable terminations for cable entering from below and a flanged throat for direct connection to the associated transformer or a bus throat for connection to the associated metal-enclosed bus, or roof bushings for aerial line connections shall be provided. Roof bushings shall be one BIL higher than the associated switchgear and shall conform to IEEE C57.19.00 and IEEE C57.19.01 when bushings are rated at or above 110 kV BIL. Primary buses shall comply with the requirements for buses in paragraph OUTGOING METAL-CLAD SWITCHGEAR.

2.3.4.1.1 Ratings

Switch ratings at 60 Hz shall be in accordance with IEEE C37.2, and IEEE C37.06.

2.3.4.1.2 Operating Mechanism Controls and Devices

An operating mechanism cabinet shall house the electrical devices listed below, which shall be rated for the application and shall be suitable for

the ac or dc control voltage available as shown or specified. Unless otherwise noted, provide manufacturer's standard devices for the rating specified including the following:

a. A light connected to a cabinet door-actuated switch, so that the light is energized only when doors are open.

b. A heater continuously energized to prevent condensation within the cabinet over ambient temperature ranges from [minus 20] [_____] to [104] [_____] degrees F at 90 percent relative humidity and connected to a cabinet door-actuated switch, so the heater is de-energized when doors are open. High-temperature thermal protection shall be included.

c. An operator charging motor with thermal-overload relays.

d. A motor control contactor with relays, solenoids, and any other control devices required.

e. Necessary motor-alarm and interlock switches.

f. One-pole or two-pole thermal-magnetic molded-case circuit breakers suitable for the operating voltage for control, heater, and light circuits.

g. A minimum of eight spare circuit breaker auxiliary contacts, four normally open (52a) and four normally closed (52b), wired to interface terminals.

h. Terminal facilities wired for devices installed in the cabinet, and to permit corresponding connections of incoming conductors from remote items of equipment.

i. A key interlock if indicated.

j. A switch-operating handle with provisions for locking in either the open or closed position.

k. Safety devices as necessary to ensure that the load interrupter switch is in the open position whenever unit doors are in the open position.

l. An interface terminal block wired for required exterior connections.

m. Devices specified under specific unit requirements below.

2.3.4.1.3 Sulfur Hexafluoride (SF6) Interrupter Switchgear

Provide SF6 interrupters of the puffer type where the movement of the contact plunger will initiate the puff of SF6 gas across the contact to extinguish the arc. Switchgear shall be provided with a loss-of-pressure alarm remote as shown on the drawings. Before the pressure in the interrupter drops below the point where the interrupter cannot open safely without damage, the switchgear shall activate the loss-of-pressure alarm, open automatically, and remain in the locked open position until repaired. The SF6 shall meet the requirements of ASTM D2472, except that the maximum dew point shall be minus 76 F (corresponding to 11 ppm water by volume), with only 11 ppm water by volume, and the minimum purity shall be 99.9 percent by weight. Switchgear shall have provisions for maintenance slow closing of contacts and have a readily accessible contact wear indicator. Tripping time shall not exceed 5 cycles.

2.3.4.1.4 Vacuum Circuit Interrupter Switchgear

Vacuum interrupters shall be hermetically-sealed in a high vacuum to protect contacts from moisture and contamination. Switchgear shall have provisions for maintenance slow closing of contacts and have a readily accessible contact wear indicator. Tripping time shall not exceed 5 cycles.

2.3.4.1.5 Specific Unit Requirements

In addition to basic requirements, switchgear shall contain other devices as appropriate to the application and as specified in paragraph SUBSTATION EQUIPMENT.

2.3.4.2 Devices and Accessories for Switching/Interrupting Equipment

2.3.4.2.1 Incoming Line

Coordinate lncoming line units with the requirements of the serving utility, and to the protected transformer, and include the following control and monitoring system items that shall be mounted in the instrument and relay cabinet specified below.

a. An ammeter and an ammeter switch.

b. A control switch for local or remote control operation.

c. Three overcurrent relays, devices 50/51.

d. One residually-connected ground-overcurrent relay, device 50/51N.

e. Three directional overcurrent relays, device 67.

f. One ground-directional-overcurrent relay, device 67N.

g. Three transformer differential relays, device 87T and an auxiliary lockout relay, device 86T located in the associated metal-clad switchgear or located in the instrument and relay cabinet.

h. Single- or Three- phase secondary potential test blocks with associated test plug, quantity as shown.

i. Single- or Three- phase secondary current test blocks with associated test plug for each current transformer circuit or each three-phase set of current transformers.

2.3.4.2.2 Line Tie

The line tie units shall be rated the same as the incoming line units, and shall be electrically or mechanically interlocked with other high-voltage items of equipment as shown. The line tie unit shall be equipped with control and monitoring system items the same as described for the incoming line unit. The instrument and relay cabinet shall house the same equipment listed for the incoming line unit cabinet. The cabinet shall also house three bus differential relays, device 87B, and an auxiliary lockout relay, device 86B.

2.3.4.2.3 Instrument and Relay Cabinet

Provide enclosures for housing instruments, relays, and devices specified. Install devices such as instruments, relays, and control and transfer switches in the metal-clad switchgear lineup or an instrument and relay cabinet. Enclosures shall comply with NEMA 250 and paragraph CABINETS AND ENCLOSURES. Rigid supports, conduits, fittings, raceways, troughs, etc., shall be provided for mounting and connection to the associated equipment. Standard enclosure equipment shall include the following:

a. A light connected to a cabinet door-actuated switch, so that the light is energized only when doors are open.

b. A heater continuously energized to prevent condensation within the cabinet over an ambient temperature range of [minus 20] [_____] to [104] [_____] degrees F. Connect the heater and thermostat contact to a cabinet door-actuated switch, so that the heater is de-energized when the cabinet door or doors are open. High temperature thermal protection shall be included.

c. One-pole or two-pole thermal-magnetic molded-case circuit breakers suitable for the operating voltage for heater and light circuits.

d. Devices identified under specific unit requirements hereinafter.

2.3.4.3 Power Fuse Disconnecting Units

Incoming line power fuse disconnecting units, consisting of power fuses and fuse disconnecting switches. Expulsion-type or current-limiting power disconnecting units and fuses shall have ratings in accordance with IEEE C37.46.

2.3.4.3.1 Power Fuse Disconnecting Unit Ratings

Power disconnecting units shall have ratings as required:

Nominal voltage	As Required
Rated maximum voltage	As Required
Maximum symmetrical interrupting capacity	As Required
Rated continuous current (kA)	As Required
BIL (Impulse Level)	As Required

2.3.4.3.2 Construction

Units shall be suitable for outdoor use and shall be of the stick (hook) operated, disconnecting, single-pole, single-throw, drop-out type. Fuses shall have visible blown-fuse indicators. All ratings shall be clearly visible. Units shall be suitable for vertical or 45 degree or horizontal underhung mounting.

2.3.4.3.3 E-Rated, Current-Limiting Power Fuses

E-rated, current limiting, power fuses shall conform to IEEE C37.46.

2.3.4.3.4 C-Rated, Current-Limiting Power Fuses

C-rated, current-limiting, power fuses shall open in 1000 seconds at currents between 170 and 240 percent of the C rating.

2.3.4.3.5 Additional Requirements

Provide at least one fuse tong or other fuse removal and replacement device of sufficient length, and suitable design and voltage rating, for disconnection and replacement of fuses, and where units mounted at different elevations require different lengths, additional devices shall be provided as necessary. One set of any special tools, necessary for servicing the unit, shall be provided.

2.3.4.4 Line Switches

2.3.4.4.1 Ratings

Ratings at 60 Hz shall be in accordance with IEEE C37.32

2.3.4.4.2 Standard Devices and Accessories

One set of special tools, as necessary for servicing, shall be provided.

2.3.4.4.3 Stick (Hook) Operated Line Switches

Stick (hook) operated line switches shall comply with IEEE C37.32 and shall be a stick-operated, single-pole, single-throw, vertical-break switch suitable for vertical or horizontal underhung mounting.

2.3.4.4.4 Group-Operated Line Switches

Group-operated line switches shall be air-insulated or SF6 insulated with manual and motor -type operators. Group-operated line switches shall comply with IEEE C37.32, IEEE C37.30, and IEEE C37.34, and shall be three-pole, single-throw, provided with a mechanism which opens the three phases simultaneously. Group-operated switches shall be manually operated and motor operated.

2.3.4.4.4.1 Air-Insulated

Air-insulated switches shall be of the vertical-break or side-break or indicated-break type, with either tilting or rotating insulators, for horizontal upright or vertical or horizontal underhung mounting. Contact surfaces shall be silver. The switching capability required shall be of the load interrupter or disconnecting type. Switches shall be provided with replaceable contacts, arc horns, and other moving parts which have a limited life expectancy.

2.3.4.4.4.2 SF6-Insulated

Switches shall be puffer-type SF6 interrupters. The interrupter shall be factory filled with SF6 gas and then permanently sealed. The interrupters shall be driven by a single, stored-energy mechanism located at ground level in an operator. The mechanism in the operator shall have

instantaneous trip-free capability (should the switch be inadvertently closed into a fault).

2.3.4.4.4.3 Load Interrupter Type, Air-Insulated

Load interrupter switches shall be capable of interrupting load currents equal to their continuous current ratings, which meet the requirements of IEEE C37.30.

2.3.4.4.4.4 Disconnecting Type, Air-Insulated

Disconnecting switches shall be provided with quick-break arcing horns rated for interrupting transformer exciting currents or line charging currents, dependent upon the application. A switch used to protect a power transformer shall be key-interlocked with its associated transformer's tap changer for de-energized operation (TCDO) and its load side circuit breaker disconnect, so that the manual TCDO can be operated only when the transformer is de-energized, and so that the switch can be only opened or closed after its associated circuit breaker has been placed in the open position. A permanent warning sign having letters at least 2 inches high and reading as follows: "WARNING - DISCONNECTING SWITCH - DO NOT OPEN UNDER LOAD" shall be mounted on the switch operating mechanism.

2.3.4.4.4.5 Manually-Operated Type, Air-Insulated

The switch operating handle shall be located approximately 3 feet 6 inches above its grounded platform plate. Insulation of the switch operating mechanism shall include both insulated interphase rod sections and the insulated vertical shaft.

2.3.4.4.5 Switch Operators

Opening and closing operating time shall be not more than 10 seconds for each operation.] Operators shall be configured so that the switch actuator is padlockable.

2.3.4.4.5.1 Operation

The operating mechanism shall permit both manual and electrical operation of the switch at its operating mechanism cabinet, and electrical operation by the remote control circuitry. The operating shaft or operator cabinet shall be clearly and permanently marked to indicate continuously the positions of the switch. An externally operable decoupler shall be provided at or near the point of entrance of the shaft into its operator housing so as to permit disengagement of the shaft for inspection, tests, maintenance, or repair of equipment located within the operator enclosure. Switch operators shall be provided with remote telemetry units (RTUs) for remote operation and integration with supervisory, control, and data acquisition systems. Systems, components, and equipment shall conform to the requirements and recommendations of IEEE C37.1.

2.3.4.4.5.2 Operating Mechanism Cabinet

A NEMA 250 enclosure complying with paragraph CABINETS AND ENCLOSURES shall be provided as suitable for the required operation. The electrical devices listed below shall be rated for the application and shall be suitable for the available low-voltage alternating or direct current. Unless otherwise noted, manufacturer's standard devices for the rating specified shall be provided and shall include the following:

a. "Trip" and "Close" pushbuttons or switch and position indication lights.

b. A switch-operation counter.

c. Shaft travel limit switches and any required safety devices.

d. A light connected to a cabinet door-actuated switch, so that the light is energized only when doors are open.

e. A heater continuously energized to prevent condensation within the cabinet over an ambient temperature range of [minus 20] [_____] to [104] [_____] degrees F at 90 percent relative humidity and connected to a cabinet door-actuated switch, so that the heater is de-energized when doors are open. High-temperature thermal protection shall be included.

f. An operator charging motor with thermal-overload relays.

g. A motor control contactor, with relays, solenoids, and any other control devices required.

h. Necessary motor-alarm and interlock switches.

i. One-pole or two-pole thermal-magnetic, molded-case circuit breakers suitable for the operating voltage for control, heater, and light circuits.

j. A minimum of eight spare motor operator auxiliary contacts, four normally open and four normally closed, wired to an interconnection terminal block.

k. An interconnection terminal block wired to permit remote open and close operations of the switch and for other required exterior connections.

l. A key interlock if specified.

m. A local-remote selector switch and position indication lights.

n. Manual trip lever and manual charging handle (in case of loss of control power.

o. "Charged" and "Discharged" indicators for stored energy mechanism.

p. Gas pressure indicator, or low gas pressure indicator.

q. Local/Remote operation selector switch.

2.3.4.4.6 Grounded Iron Platform Plate

The manually-operated, group-operated switch shall be provided with a grounded platform plate located where the switch operator would stand to manually operate the switch. The plate shall be constructed of hot-dip galvanized iron at least 1/4 inch thick and shall be approximately 4 feet in length by 2 feet 6 inches in width. The plate shall be laid on finished grade and so secured. Two ground clamps shall be provided on the plate on the side adjacent to the switch operating mechanism. Each clamp

shall be connected to the station grounding grid with a No. 4/0 AWG bare copper wire. Separate clamps and a flexible copper braid conductor shall be used to connect the plate to the switch operating handle mechanism. The cross sectional area of the braid shall be equivalent to a No. 4 AWG conductor, minimum.

2.3.5 Substation Equipment

The installation shall be of the switching station, of the primary unit substation, of the substation transformer or an articulated primary unit substation of the radial, distributed-network, spot-network secondary-selective or duplex type. Outgoing circuits shall be three-phase three-wire or four-wire type with an insulated] neutral. The insulated neutral shall have insulation rated not less than 1000 volts. Outgoing circuits shall leave the station aerially or underground or in cable trays.

2.3.5.1 Power Transformer

The power transformer shall comply with IEEE C57.12.00 and shall be of the 55/65 degrees C rise, three-phase, two-winding, mineral-oil-immersed, load-tap-changing type and shall be solidly grounded or resistance grounded through its associated neutral grounding resistor. The oil preservation system shall be either of the sealed-tank, inert-gas-pressure system as defined in IEEE C57.12.80, or conservator/diaphragm type. Temperature monitoring, indication, and automatically-controlled cooling equipment shall be as specified. The color of the transformer case and auxiliary items shall match the color used for switchgear and cabinets as specified for cabinets in paragraph CABINETS AND ENCLOSURES.

2.3.5.1.1 Ratings

Transformer losses and impedances shall be measured in accordance with IEEE C57.12.90. Ratings at 60 Hz shall be in accordance with IEEE C57.12.10

2.3.5.1.2 Auxiliary Cooling Equipment

Cooling and provision for future cooling equipment shall be provided for single-stage, forced-air-cooling, two-stage, forced-air-cooling/forced-air-cooling or forced-air-cooling/forced-oil cooling utilizing automatic control. Automatic controls, motors, heaters, and their protective devices shall be rated for the application and shall be suitable for the alternating current available. Radiator isolation valves shall be provided for bolted-on radiators. Controls for auxiliary cooling equipment shall combine the transformer top oil thermometer, device 26Q, and the transformer winding temperature simulator, device 49, suitable for responding either to the transformer's top liquid or winding temperature, and shall include auxiliary devices necessary for sensing temperature changes. These devices shall be mounted on the transformer case in a suitable housing so that maintenance is possible without removing the transformer cover or handling oil. Devices 26Q and 49 shall have three electrically independent contacts operating and wired as follows:

a. First set of contacts set to close at the manufacturer's recommended setting and wired for starting first-stage forced-air-cooled fans.

b. Second set of contacts set to close at the manufacturer's recommended

setting and wired to start the second-stage forced-air-cooling fans, or start pumps for forced-oil-cooling, or alarm terminals in the transformer terminal cabinet, or alarm terminals in the metal-clad switchgear.

c. Third set of contacts set to close at the manufacturer's recommended setting and wired to energize an auxiliary relay, device 49X. The relay shall be mounted in the transformer terminal cabinet or metal-clad switchgear. Device 49X shall be properly rated and equipped with not less than three normally open and three normally closed sets of electrically independent contacts. One set of contacts shall be wired to annunciate excessive transformer temperature.

2.3.5.1.3 Neutral Grounding Resistor

The neutral grounding resistor assembly shall comply with IEEE 32and shall be factory-mounted on the associated transformer or mounted adjacent to the associated transformer. The assembly shall meet the following:

a. The resistor element shall be stainless steel or cast-iron.

b. The resistor shall be installed in an aluminized screened or expanded galvanized steel enclosure of the personnel safety type and shall be provided with any necessary supports and mounting hardware. The enclosure, including screening and support framing, shall have two finish coats applied over a prepared substrate. The color of the finish coats shall be the same as the color of the associated transformer.

c. A stress-relief terminator shall be provided and arranged to permit the proper termination of the shielded transformer neutral cable entering the enclosure as recommended by the manufacturer. If the terminal bushing is external to the enclosure, the bushing and terminal provisions shall be enclosed by a solid metal cable box equipped with conduit fittings correctly sized for the conduit required. An approved type and size of terminal lug shall also be provided and arranged for the field termination of the No. 4/0 AWG bare copper grounding cable entering the enclosure from the bottom.

d. One current transformer conforming to the requirements of paragraph INSTRUMENT TRANSFORMERS shall be provided and housed in the resistor enclosure. The current transformer shall have the ratio shown and be connected to the associated overcurrent relay, device 51G, located in the metal-clad switchgear or instrument and relay cabinet specified above. The terminals of the current transformer shall be wired with not less than No. 10 AWG conductors to the proper terminals of device 51G through a short-circuiting type of terminal block and test block located in the metal-clad switchgear, instrument and relay cabinet, or transformer terminal cabinet.

2.3.5.1.4 Load-Tap-Changing Equipment

Load-tap-changing equipment shall be provided to provide automatic adjustment of a transformer's low-voltage winding voltage. In addition to the basic load-tap-changing equipment requirements listed in IEEE C57.12.10, the load-tap-changing equipment shall include the following:

a. A light wired in series with the control cabinet door-actuated switch, so that the light is energized only when the door or doors are open.

b. A heater continuously energized to prevent condensation within the control cabinet over ambient temperature ranges from [minus 20] [_____] to [104] [_____] degrees F, with both the heater and thermostat contact wired in series with the control cabinet door-actuated switch, so that the heater is de-energized when doors are open. High-temperature thermal protection shall be included.

c. One-pole or two-pole thermal-magnetic molded-case circuit breakers suitable for the control voltage, when required by the manufacturer, and for low-voltage alternating-current power to control devices, motor, heater, and light circuits.

d. Terminal blocks wired for proper interconnection with remote items of equipment.

e. Circulating-current equipment necessary to allow parallel operation of the transformer.

f. Reverse power flow equipment wired so that the load-tap-changer functions only when electric power flows from high-voltage to low-voltage windings in the transformer.

2.3.5.1.5 Bushings and Equipment Connection Provisions

Bushings and equipment connection provisions shall be provided as specified for Primary Unit Substation, Substation Transformer, or Articulated Primary Unit Substation in paragraph SUBSTATION EQUIPMENT. Primary and secondary cover bushings for high- and low-voltage line and neutral connections shall conform to the requirements of IEEE C57.19.00 and IEEE C57.19.01 and shall be one BIL higher than the associated power transformer's high- and low-voltage BIL ratings respectively.

2.3.5.1.6 Accessories

Transformers shall be provided with the accessories listed below. Contact devices for remote control features shall be rated for the application and shall be suitable for the low-voltage ac or dc available.

a. A tap-changer for de-energized operation (TCDO) provided with padlock provision and key-interlocked with the disconnecting switch protecting the associated transformer.

b. A liquid-level indicator and relay (device 71L), shall be provided with two sets of normally-open and normally-closed contacts, one set for low-liquid-level and the other set for high-liquid-level. The contacts shall be rated for the application and wired to one annunciator alarm point.

c. A pressure-vacuum gauge when the transformer is provided with a sealed-tank or inert gas-pressure oil preservation system.

d. Drain and filter valves.

e. Lifting, moving, and jacking facilities.

f. Two transformer case grounding lugs for termination of No. 4/0 AWG bare copper cables.

g. Sudden Pressure Relay: A sudden pressure relay, device 63SPR, shall be provided as an integral part of the transformer. A set of contacts of device 63SPR shall be wired to energize an auxiliary relay, device 63X, transformer terminal cabinet, metal-clad switchgear, and instrument and relay cabinet. A set of contacts of device 63X shall be wired to energize the transformer lockout relay, device 86T. In turn, contacts of device 86T shall be wired to annunciate abnormal transformer pressure and trip the main secondary breaker and the circuit breaker on the primary side of the faulted transformer.

2.3.5.1.7 Miscellaneous Items

Miscellaneous items for a transformer shall include the following:

2.3.5.1.7.1 Terminal Cabinet

A weatherproof transformer terminal cabinet for circuits which are connected to devices not mounted integrally on a transformer, but remotely (such as in switchgear units) including interconnection terminals for any future cooling circuits. The gauge of metal for the cabinet shall be the manufacturer's standard. Color of the cabinet shall match the color of the associated transformer. The door or doors of the cabinet shall be equipped with padlocking provisions.

2.3.5.1.7.2 Connections

Raceway connections and associated interconnection wiring between a transformer terminal cabinet and any remote devices which operate in conjunction with transformer-mounted devices, including necessary wiring for remote control features and for cooling circuits. Remote control features include the tripping of associated primary and secondary circuit breakers and the actuation of the associated annunciator circuits by the indicated transformer control or accessory contact.

2.3.5.1.7.3 Delivery State

The transformer shall be shipped from the factory already filled with oil, if possible. If the transformer must be vacuum filled in the field, a four inch NPT nipple, with cap for the vacuum line, shall be added to the cover, away from the fill valve.

2.3.5.2 Primary Unit Substation

Primary unit substations shall comply with IEEE C37.121, shall be suitable for outdoor installation, and shall consist of transformer section equipment directly connected to outgoing section equipment.

2.3.5.2.1 Transformer Section Equipment

Transformer section equipment shall comply with the requirements for power transformers in paragraph SUBSTATION EQUIPMENT.

2.3.5.2.2 Outgoing Section Equipment

Outgoing section equipment shall comply with the requirements of paragraph OUTGOING METAL-CLAD SWITCHGEAR.

2.3.5.3 Substation Transformer

Substation transformer shall comply with the requirements for power transformers in paragraph SUBSTATION EQUIPMENT.

2.3.5.4 Articulated Primary Unit Substation

Articulated primary unit substation shall comply with IEEE C37.121 and shall be of the outdoor radial, secondary-selective, distributed-network, spot-network, or duplex type.

2.3.5.4.1 Incoming Section Equipment

Incoming section equipment shall comply with the requirements for Metal-Enclosed Interrupter Switchgear in paragraph INCOMING SWITCHING/CIRCUIT INTERRUPTING EQUIPMENT or in paragraph OUTGOING METAL-CLAD SWITCHGEAR.

2.3.5.4.2 Transformer Section Equipment

Transformer section equipment shall comply with the requirements for power transformers in paragraph SUBSTATION EQUIPMENT. Primary and secondary equipment connection provisions shall be suitable for direct connection to the specified incoming and outgoing switchgear.

2.3.5.4.3 Outgoing Section Equipment

Outgoing section equipment shall comply with the requirements of paragraph OUTGOING METAL-CLAD SWITCHGEAR.

2.3.5.5 Metal-Enclosed Bus

Metal-enclosed bus shall have ratings that equal or exceed the ratings of the buses, circuit breakers, and switchgear to which the bus is connected, unless otherwise indicated. The bus shall conform to the requirements of IEEE C37.23. Bus shall be of the nonsegregated-phase type. A ground bus or neutral bus is required. The enclosure is to be the nonventilated type constructed of selected smooth sheet steel, and shall be equipped with continuously energized space heaters (with high-temperature thermal protection) to prevent condensation over an ambient temperature range of [minus 20] [_____] to [104] [_____] degrees F. The finish of the enclosure shall be in accordance with the manufacturer's standard.

2.3.6 Outgoing Metal-Clad Switchgear

Switchgear shall comply with IEEE C37.20.2 and shall be of the outdoor type consisting of incoming line, tie, auxiliary compartments and feeder circuit breaker units. Compartments shall be provided to accommodate specified or indicated auxiliary equipment. The indicated number of active and future circuit breakers and equipped cubicles shall be provided. Current transformers, instruments, instrument switches, and relays shall be provided for equipped space. Continuous current rating of equipped space units shall match the most common basic breaker unit ampere rating used elsewhere in the associated switchgear. Switchgear shall be vented according to the manufacturer's standard practice. Intake and exhaust openings shall be screened. Switchgear shall have relaying.

2.3.6.1 Ratings

Main buses shall be three-phase three-wire or four-wire. Switchgear ratings at 60 Hz shall be in accordance with IEEE C37.06.

2.3.6.2 Circuit Breakers

Circuit breakers shall comply with IEEE C37.04 and IEEE C37.06. Bus or lug connections to mount field-installed, slip-on, medium-voltage cable terminations for cable entering from below and a flanged throat for direct connection to the associated transformer, or a bus throat for connection to the associated metal-enclosed bus, or roof bushings for aerial line connections shall be provided. Roof bushings shall be one BIL higher than the associated switchgear and shall conform to IEEE C57.19.00 and IEEE C57.19.01. Circuit breakers shall be of the vacuum or sulfur hexafluoride (SF6) drawout type having electrically charged, stored-energy mechanisms which are mechanically and electrically trip free. A means for manual charging of each trip mechanism shall be provided. Circuit breakers of the same ampere rating shall be interchangeable, both mechanically and electrically. Each circuit breaker shall have a cell-mounted switch assembly for control and interlocking. Cell switches may be connected either in parallel or in series with control contacts that are used for interlocking, but either connection shall permit operation of a circuit breaker when it is in a test position. In addition to any contacts used or shown, each circuit breaker shall be provided with four spare auxiliary and cell contacts, two normally open and two normally closed, wired to interconnection terminals. If auxiliary relays are used to provide additional contacts, such relays shall not be of the latching type. Interconnection terminal blocks shall be wired to permit remote open and close operations of each circuit breaker and for other required exterior connections or connections between switchgear sections.

2.3.6.2.1 Vacuum Circuit Interrupters

Vacuum interrupters shall be hermetically-sealed in a high vacuum to protect contacts from moisture and contamination. Circuit breakers shall have provisions for maintenance slow closing of contacts and have a readily accessible contact wear indicator. Tripping time shall not exceed 5 cycles.

2.3.6.2.2 Sulphur Hexafluoride (SF6) Interrupters

SF6 interrupters shall be of the puffer type where the movement of the contact plunger will initiate the puff of SF6 gas across the contact to extinguish the arc. Breakers shall be provided with a loss-of-pressure-alarm remote as shown on the drawings. Before the pressure in the interrupter drops below the point where the breaker or switch cannot open safely without damage, the breaker shall activate the loss-of-pressure-alarm, open automatically, and remain in the locked open position until repaired. The SF6 shall meet the requirements of ASTM D2472, except that the maximum dew point shall be minus 76 degrees F (corresponding to 11 ppm water by volume), with only 11 ppm water by volume, and the minimum purity shall be 99.9 percent by weight. Circuit breakers shall have provisions for maintenance slow closing of contacts and have a readily accessible contact wear indicator. Tripping time shall not exceed 5 cycles.

2.3.6.3 Buses

Copper bus shall comply with ASTM B188. Equivalent aluminum bus shall comply with ASTM B317/B317M. Bolted or pressure joints for main and ground buses, interconnections, and external connections to equipment shall be of the silver-to-silver or the silver-to-tin high-pressure type. Bolted connections shall have a minimum of two bolts, except for the ground bus where one bolt will suffice. Each nut on any bolted connection shall be secured with a belleville washer or other locking means torqued in accordance with manufacturer's recommendations. Bus supporting elements shall be bolted to switchgear enclosures and shall comply with IEEE C37.20.2.

2.3.6.3.1 Main Buses

Main buses and connections shall have at least the same short-circuit current rating as circuit breakers. Buses may be copper or aluminum, but a combination of both metals is not acceptable unless silver-to-silver or silver-to-tin plating is used wherever aluminum and copper buses are connected.

2.3.6.3.2 Ground Buses

Uninsulated copper ground buses, not less than 2 by 1/4 inch in cross-sectional area, shall be provided for the full length of a switchgear lineup. Ground buses of aluminum are not acceptable. The short-circuit current rating of the ground bus shall be at least equal to the short circuit current rating of the primary bus. Compression indent type cable lugs shall be provided at each end of a ground bus for connection of No. 4/0 AWG copper ground cables.

2.3.6.3.3 Control Buses

Control buses shall be provided as necessary to supply power to control devices.

2.3.6.4 Control Power Transformers

Control power transformers shall comply with IEEE C57.12.01, shall be of the ventilated dry type. The BIL rating shall equal or exceed the BIL rating of the switchgear. Transformer current-limiting primary fuses shall be drawout type and shall be interlocked with a secondary molded case circuit breaker provided as a part of the transformer installation. Molded case circuit breakers shall comply with UL 489. It shall not be possible to open the primary fuse compartment unless this secondary circuit breaker is in the open position. Construction shall be of the drawout type for either the complete assembly or for primary fuses only, according to the manufacturer's standard. Mechanical interlocks shall prevent removal of primary fuses, unless the associated assembly is in a drawout or disconnected position. Transformer compartments shall have hinged doors.

2.3.6.5 SUBSTATION AND SWITCHGEAR PROTECTIVE RELAYS

2.3.6.5.1 General

[Solid-state] [and] [Electromechanical] [and] [Microprocessor-based] protective relays shall be provided as shown and shall be of a type specifically designed for use on power switchgear or associated electric

power apparatus. Protective relays shall conform to IEEE C37.90. Relays and auxiliaries shall be suitable for operation with the instrument transformer ratios and connections provided.

2.3.6.5.2 Construction

Relays shall be of the semi-flush, rectangular, back-connected, dustproof, switchboard type. Cases shall have a black finish and window-type removable covers capable of being sealed against tampering. Relays shall be of a type that can be withdrawn, through approved sliding contacts, from fronts of panels or doors without opening current transformer secondary circuits, disturbing external circuits, or requiring disconnection of any relay leads. Necessary test devices shall be incorporated within each relay and shall provide a means for testing either from an external source of electric power or from associated instrument transformers. Each relay shall be provided with an operation indicator and an external target reset device. Relays shall have necessary auxiliaries for proper operation. Relays and auxiliaries shall be suitable for operation with the instrument transformer ratios and connections provided.

2.3.6.5.3 Ratings

Relays shall be the manufacturer's standard items of equipment with appropriate ranges for time dial, tap, and other settings. Relay device numbers shall correspond to the function names and descriptions of IEEE C37.2.

2.3.6.5.4 Overcurrent Relays

2.3.6.5.4.1 Phase Overcurrent Relays for Main [and Tie] Circuit Breakers

Phase overcurrent relays for main [and tie] circuit breakers shall be single-phase, nondirectional, [induction] [solid-state] [microprocessor-based] type, time delay, device 51, current taps [[_____] to [_____] amperes] with characteristic curves that are [definite time] [moderately inverse] [inverse] [very inverse] [extremely inverse].

2.3.6.5.4.2 Ground Overcurrent Relays for Main Circuit Breakers

Ground overcurrent relays for main circuit breakers shall be nondirectional, [induction] [solid-state] [microprocessor-based] type, time delay, device [51G wired to a current transformer in the source transformer neutral-to-ground connection] [51N, residually connected], with current taps [[_____] to [_____] amperes] [as indicated] and with characteristic curves that are [definite time] [moderately inverse] [inverse] [very inverse] [extremely inverse].

2.3.6.5.4.3 Ground Overcurrent Relays for Tie Circuit Breakers

Ground overcurrent relays for tie circuit breakers shall be nondirectional, [induction] [solid-state] [microprocessor-based] type, time delay, device 51N, residually connected, with current taps [[_____] to [_____] amperes] and with characteristic curves that are [definite time] [moderately inverse] [inverse] [very inverse] [extremely inverse].

2.3.6.5.4.4 Phase Overcurrent Relays for Feeder Circuit Breakers

Phase overcurrent relays for feeder circuit breakers shall be

single-phase, nondirectional, [induction] [solid-state] [microprocessor -based] type, time delay, device 50/51, with instantaneous-current pick-up range [[_____] to [_____] amperes], with time-delay-current taps [[_____] to [_____] amperes] [as indicated] and with characteristic curves that are [definite time] [moderately inverse] [inverse] [very inverse] [extremely inverse].

2.3.6.5.4.5 Ground Overcurrent Relays for Feeder Circuit Breakers

Ground overcurrent relays for feeder circuit breakers shall be nondirectional, [plunger] [solid-state] [microprocessor-based] type instantaneous, device [50GS wired to a ground sensor current transformer] [50N, residually connected], with current pick-up range [[_____] to [_____] amperes].

2.3.6.5.5 Directional Overcurrent Relays

2.3.6.5.5.1 Directional Phase Overcurrent Relays

Single-phase, [induction] [solid-state] [microprocessor-based] type with instantaneous units. Phase relays, device 67, shall have an instantaneous-current pick-up range [[_____] to [_____] amperes], with time-delay-current taps [[_____] to [_____] amperes] and with characteristic curves that are [definite time] [moderately inverse] [inverse] [very inverse] [extremely inverse].

2.3.6.5.5.2 Directional Ground Overcurrent Relays

Device 67N, shall have an instantaneous-current pick-up range [[_____] to [_____] amperes], with time-delay-current taps [[_____] to [_____] amperes] [as indicated] and with characteristic curves that are [definite time] [moderately inverse] [inverse] [very inverse] [extremely inverse].

2.3.6.5.6 Automatic Reclosing Relay

Relay, device 79, shall be of the three-phase, four-reclosure type, providing immediate initial reclosure, and three time-delay reclosures. Adjustable time delays shall be 10 to 60 seconds for reset and 0 to 45 seconds for reclosing. Units shall have instantaneous trip lockout after any preset trip or when closing in on a fault. Auxiliary devices shall provide for lockout when an associated circuit breaker is tripped after three reclosures and automatically reset when an associated circuit breaker is not tripped after any reclosure.

2.3.6.5.7 Transformer Differential and Lockout Relays

Differential relays, device 87T, shall be of the three-phase or the single-phase high-speed [_____] [percentage] [_____] differential type suitable for the protection of two-winding transformers, and shall be provided with a harmonic-restraint feature. Lockout relay, device 86T, shall be of the type which, when used in conjunction with the 87T relay, trips and locks out the indicated circuit breakers.

2.3.6.5.8 Bus Differential and Lockout Relays

Bus differential relay, device 87B, shall be of the three-phase or single-phase, high-speed impedance differential type suitable for protection of buses. Lockout relay, device 86B, shall be of a type which, when used in conjunction with the 87B relay, trips and locks out the

indicated circuit breaker.

2.3.6.6 Control and Instrument Switches

Control and instrument switches shall be of the rotary switchboard type rated for alternating-current operation at 600 volts, or direct-current operation at 250 volts for dc circuits, as applicable. Contacts shall be rated for not less than a continuous current of 20 amperes, shall be of the silver-to-silver type, and shall have positive means for maintaining contact. Each switch shall be provided with a black operating handle, and an escutcheon clearly marked to show each operating position. Switch identifications and handle positions shall be engraved on escutcheons or may be provided on separate nameplates. Escutcheon engravings shall be white on a black background or black on a white background. Instrument switches for potential phase selection shall be provided with an oval handle. Ammeter switches for phase selection shall have round, notched, or knurled handles and equipped with short-circuiting type of contacts to prevent open-circuiting of current transformer secondary circuits in any position of the ammeter switches. Switches provided for circuit breaker control and local-remote selector switches shall have a pistol-grip handle and a mechanical target to indicate the last operating position of the switch. Red and green circuit breaker position indication LED lights shall be installed immediately above each circuit breaker switch. Local-remote selector switches shall be provided only when shown or specified. Position indication lights shall be installed immediately above selector switches, with blue LED lights indicating remote control and amber LED lights indicating local control.

2.3.6.7 Electrical Indicating Instruments

Electrical indicating instrument relays shall comply with ANSI C12.1, NEMA C12.4, and NEMA/ANSI C12.10.[Electrical indicating instruments shall be of the semiflush, back-connected, dustproof, direct-reading, switchboard type, approximately 4-1/4 inches square, with white dials, black markings, black pointers, and scale arcs of approximately 250 degrees. Cases shall have a black finish and shadowproof viewing covers. The accuracy of each instrument shall be within 1 percent of full scale. Moving elements shall be provided with zero adjustments readily accessible from instrument fronts without disassembly. Each instrument shall be accurately calibrated for use with the associated instrument transformers, and shall have the indicated scale or a scale suitable for the application, where a specific scale is not indicated. Except for ammeters and voltmeters or unless otherwise specified or approved, the nominal or full-load values shall appear at the approximate mid-point, or the 12 o'clock position, of the scales.][Electrical instrumentation devices shall be compatible as a system, sealed, dust and water tight, utilize modular components with metal housings and digital instrumentation. Date display shall utilize LED or back-lit LCD. Numeral height shall be [1/2 inch][_____].]

2.3.6.7.1 Wattmeters

Wattmeters shall comply with ANSI C12.1 and NEMA/ANSI C12.10 except for mounting and shall be the three-phase, [four-wire type with three current coils and three potential coils] [three-wire type with two current coils and two potential coils].

2.3.6.7.2 Varmeters

Varmeters shall be the center-zero type and provided with integral or separate phase-shifting transformers or compensators. Varmeter shall be the three-phase, [four-wire type with three current coils and three potential coils] [three-wire type with two current coils and two potential coils]. Varmeters shall have dial markings and be so wired that incoming VAR readings shall be to the left of zero and outgoing VAR readings shall be to the right of zero. Dials shall be so labeled.

2.3.6.7.3 Ammeters and Ammeter Switches

Ammeters shall be calibrated to indicate full-load current when supplied with a current of 5 amperes. Full-load current shall be indicated by the pointer at approximately [mid-scale] [75 percent of the full-scale range]. Ammeter switches shall be of the short-circuiting type provided with an off position, wired for indication of current in each phase, and shall be provided for each ammeter shown or specified.

2.3.6.7.4 Voltmeters and Voltmeter Switches

Voltmeters shall be provided with expanded scales and calibrated to indicate the nominal [phase-to-phase] [and] [phase-to-neutral] voltages at approximately mid-scale. A voltmeter switch shall be provided with an off position, wired for indication of applicable voltages, and shall be provided for each voltmeter shown or specified.

2.3.6.7.5 Demand Registers

Demand registers shall comply with NEMA C12.4.

2.3.6.8 Electrical Recording Instruments

Electrical recording instruments shall be of the [direct-acting] [null-balancing] type. Instrument switches shall be provided when shown or required to select between different quantities to be recorded, and shall comply with the preceding requirements for instrument switches, as applicable.

2.3.6.8.1 Basic Requirements

Electrical recording instruments shall be of the semi-flush, back-connected, dustproof, switchboard and inkless type. The case shall have a black finish and shadowproof viewing windows [and, insofar as is practicable, shall be of the same size, style, and appearance]. The driving motor shall be rated for 120-volt ac operation. Where ungrounded input is required to an instrument, an isolating transformer shall be provided. An instrument shall have a high visibility scale of a suitable range, and indicating pointer, and an internal fluorescent light for chart illumination. Chart speed shall be [3] [_____] inches/hour. An instrument shall be correctly calibrated for use on the secondary of any instrument transformer to which it is connected and shall have the indicated scale or a scale suitable for the application, where a specific scale is not indicated. Necessary maintenance accessories and a 6-month supply of charts shall be provided for each chart-recording instrument. Chart length shall be sufficient to permit not less than 30 days of continuous operation at the normal chart speed without the need for replacement.

2.3.6.8.2 Direct-Acting Type

Direct-acting type instruments shall be of the [single-channel,] [two-channel,] strip-chart, self-contained, continuous-marking type with a chart channel calibrated width of not less than 4 inches.

2.3.6.8.3 Null-Balancing Type

Null-balancing type instruments shall be of strip-chart, self-contained, direct-current potentiometer, periodic-marking type provided with an associated and coordinated transducer for conversion of the measured alternating-current quantity to the direct-current input required for the instrument. Charts shall have a calibrated width of not less than 9 inches. An instrument shall be provided with an internal lamacoid legend plate suitably engraved, a chart supply indicator, a chart tear-off without indices, a rubber chart identification stamp reading the same as the legend plate, a chart reroll, a writing table, and an electric power "ON-OFF" switch. The chart reroll shall be self-aligning, smooth in operation, self-contained in the instrument case, and accessible for the changing of chart rolls. The writing table shall be located under the uncovered part of the chart between the indicator and reroll in such manner as to permit convenient writing on the chart by merely opening the front hinged cover, and shall be designed so that it will not interfere with replacement of charts or access to the recorder mechanism. The chart drive motor shall drive the chart through suitable reduction gearing and shall have sufficient torque to start the chart when operating on 80 percent of its rated voltage. The motor control switch shall be located [within the case so that it can be conveniently reached to start or stop the motor] [_____]. A recorder operation selector switch shall be interlocked with its associated medium-voltage circuit breaker to allow either continuous operation of the instrument or automatic isolation of the instrument when the circuit breaker is in the tripped or test position.

2.3.6.8.4 Transducers

Transducers may be integral with an instrument or may be a separate unit and shall be of the [unidirectional] [bidirectional] constant-current type providing an analog signal directly proportional to the instantaneous quantity measured. Ratings at 60 Hz shall be for a 120-volt nominal input voltage, a 150-volt overload voltage, a 5-ampere nominal input current, a 10-ampere continuous overload current, a 250-ampere 1-second instantaneous overload current, and provide an accuracy of plus or minus 0.5 percent. The maximum individual instrument transformer burden shall not exceed 4 volt amperes. Output at full scale shall not exceed one mA.

2.3.6.9 Accumulative Meters

Accumulative type meters shall be provided as shown to measure real [and reactive] power consumed, and shall be rated for use with instrument transformers shown. [Meters shall be equipped with demand pointers.] [Compensators or phase-shifting transformers shall be provided for instruments used to measure reactive power.] [Meters shall be equipped with detents to prevent negative registration.]

2.3.6.9.1 Construction

Meters shall be of the semiflush, back-connected, dustproof, drawout switchboard type. Cases shall have black finish and window-type removable covers capable of being sealed against tampering. Meters shall be of a

type that can be withdrawn, through approved sliding contacts, from fronts of panels or doors without opening current-transformer secondary circuits, disturbing external circuits, or requiring disconnection of any meter leads. Necessary test devices shall be incorporated within each meter and shall provide means for testing either from an external source of electric power or from associated instrument transformers.

2.3.6.9.2 Ratings

Meters shall be [_____]-stator, three-phase, [_____]-wire, [_____] element rated for 120-volt, 2.5 ampere, 60 Hz ac operation calibrated for use with associated instrument transformers. Meters shall have primary-rated, direct-reading registers with not less than four dials. The register multiplying factor shall be [_____]. Demand meters shall have [15-minute] [[_____]-minute] demand registers.

2.3.6.9.3 Adjustments, Registration Errors, and Other Requirements

Calibrating adjustments for light load and for full load shall be of the micrometer type, and adjustable from the front of the meter. Adjustments shall be provided for power factor and torque balance. The periphery of the discs shall be provided with standard notching to permit direct comparison with a stroboscopic type standard meter. Potential indicating lamps shall be provided in the potential coil circuits. The current coils shall be capable of withstanding the mechanical and thermal stresses imposed by a current 35 times normal applied for at least 0.5 second. The registration errors of a meter for both unity and 50 percent lagging power factor shall not exceed those listed below when tested at rated voltage, frequency, temperature, and full load current, except as otherwise stated.

a. Errors due to applied current shall be not more than 1 percent at 10 percent to 50 percent of the rated current and 0.5 percent at 50 percent to 150 percent of the rated current.

b. Errors due to applied potential shall be no more than 0.5 percent over a range of plus or minus 10 percent of the rated voltage.

c. Errors due to applied frequency shall be no more than 0.004 percent between 59 and 61 Hz.

d. Errors due to a change in ambient temperature shall be no more than 0.5 percent over a range of 64 to 104 degrees F.

2.3.6.10 Test Blocks and Accessories

Test blocks and their associated testing accessories shall be provided for testing of instruments and protective relays that require periodic testing or calibration in-place, but which are not equipped with integral testing features. Test blocks with covers shall be mounted near the base of the switchgear unit beneath the devices to be tested, and shall be provided with a nameplate engraved to identify individual current or potential test blocks, or a combination current/potential test block, as applicable. Combination test blocks shall not exceed 10 poles. Current test blocks shall be the short-circuiting type. Test devices shall be provided for insertion into the associated test block to permit application of the proper current or potential source for testing and calibration. Test devices shall be rated not less than 20 amperes and 125 volts dc.

2.3.6.11 Specific Unit Requirements

In addition to the basic circuit breaker unit requirement listed in NEMA SG 6, each individual unit or section shall contain other devices as required for the application. The following requirements are not to be considered complete in every detail and miscellaneous equipment and devices necessary for correct operation, shall be provided as necessary. Protective relays, meters, instruments, and control and instrument switches, shall be mounted [on a swinging panel located behind the exterior door of no-aisle switchgear] [on a unit or compartment door]. [Where space is not available for these devices, indicated devices may be installed on auxiliary compartment doors as shown.] [Devices specified in paragraph [INCOMING LINE SWITCHING EQUIPMENT] [and paragraph] [SUBSTATION EQUIPMENT] to be installed in the metal-clad switchgear.]

2.3.6.11.1 Incoming Line and Transformer Main Secondary Units

Units shall be coordinated with the [requirements of the serving utility] [and] [the transformer to be protected] and shall include the following:

a. [Three] [Six] [_____] current transformers.

b. Ammeter and an ammeter switch.

c. [Voltmeter] [Voltmeter, recording type] and a voltmeter switch.

d. Watthour [demand] meter.

e. Wattmeter [, recording type].

f. Varmeter [, recording type].

g. Duplex watt-varmeter, recording type.

h. Watt transducer integral with the associated wattmeter or mounted on the [back of a section door] [interior panel].

i. VAR transducer integral with the associated varmeter or mounted on the [back of a section door] [interior panel].

j. Three overcurrent relays, device 51.

k. Three directional overcurrent relays, device 67.

l. Overcurrent relay, device 51 [N] [G] [connected to the associated transformer neutral [grounding resistor] current transformer].

m. Directional overcurrent relay, device 67N.

n. One three-phase or three single-phase transformer differential relays, device 87T, and an auxiliary lockout relay, device 86T, arranged to trip and to lock out this circuit breaker and the associated transformer primary circuit breaker.

o. One three-phase or three single-phase bus differential relays device 87B, and an auxiliary lockout relay, device 86B, arranged to trip and lock out the associated circuit breaker and other circuit breakers.

p. [Single-] [Three-] phase secondary potential test blocks with

associated test devices, quantity as shown.

q. [Single-] [Three-] phase secondary current test blocks with associated test devices, quantity as shown.

r. Key-interlocking shall be provided with the primary disconnecting switch serving the associated transformer.

[s. [_____].]

2.3.6.11.2 Auxiliary Compartments

Control and instrument transformers and panelboards shall be provided and housed in compartments, [unless otherwise noted,] and shall supply control power and instrument voltage to each bus section of the switchgear lineup and remote devices as required. Compartments shall be provided with a hinged door. Any interconnection wiring and conduit needed to connect the switchgear lineup or other devices requiring control power or instrument voltage shall be provided. Equipment items shall include the following:

a. [Three] [_____] potential transformers.

b. [_____] control power transformers.

c. [_____] low-voltage alternating-current panelboards and [_____] low-voltage direct-current panelboards with main and branch circuits as shown [, located in the switchgear aisle where indicated] [, and with equipment as specified in paragraph AUXILIARY SUBSTATION EQUIPMENT].

[d. [_____].]

2.3.6.11.3 Bus Tie Unit

[The unit shall be electrically interlocked with [incoming line] [transformer main secondary] units.]

2.3.6.11.4 Feeder Units

Units shall be provided for the protection of outgoing feeder circuits and shall include the following:

a. [Three] [Six] [Nine] current transformers. [One ground sensor current transformer.]

b. Ammeter and an ammeter switch.

c. Three overcurrent relays, device [50] [51].

d. Ground overcurrent relay, device [50GS] [50N].

e. Wattmeter.

f. An automatic-reclosing relay, device 79.

g. [Single] [Three] phase secondary potential test blocks with associated test devices, quantity as shown.

h. [Single] [Three] phase secondary current test blocks with associated

test devices, quantity as shown.

[i. [_____].]

2.3.6.12 Miscellaneous Items

2.3.6.12.1 Space Heating and Ventilation

Continuously-energized space heaters (with high-temperature thermal protection) shall be installed in each switchgear unit and auxiliary compartment in accordance with the manufacturer's standard practice and shall be sized to prevent condensation over an ambient temperature range of [minus 20] [_____] to [104] [_____] degrees F. Aisle ventilation fans shall be provided where indicated and shall be sized to provide at least 10 air changes per hour. Fans shall be wired to three-way switches located at each end of the switchgear aisle and adjacent to aisle lighting switches. In addition, fans shall be thermostatically controlled to turn fans on when interior temperatures exceed 104 degrees F.

2.3.6.12.2 Aisle Lighting

Fluorescent luminaires shall be a manufacturer's standard fixture equipped with a cold-weather ballast, and installed in the switchgear aisle to provide a maintained lighting intensity level of 50 footcandles at floor level in the aisle and on faces of units and compartments. Luminaires shall be wired to three-way switches located at each end of the switchgear aisle.

2.3.6.12.3 Duplex Receptacles

Duplex receptacles shall be installed on each end wall of the switchgear aisle and at approximately 6-foot intervals along the exterior wall of the aisle. Receptacles and receptacle plates shall be ivory in color. Receptacles shall be the two-pole, three-wire, grounded type rated at 15 amperes and 125 volts, NEMA WD 1 configuration 5-15R.

2.3.6.12.4 Lighting and Appliance Branch Circuit Panelboards

Lighting and appliance branch-circuit panelboards for the protection of the indicated low-voltage circuits shall be located as specified or indicated and shall conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Ratings of panelboard mains shall be compatible with the supply voltage to the panelboard. Circuit breakers in a direct-current panelboard shall be rated for [48] [125] volts dc operation.

2.3.6.13 Accessories

Accessories identified in NEMA SG 6 shall be provided for the inspection, testing, maintenance, and repair of circuit breakers, and shall include one set of any special tools, as necessary to repair and maintain circuit breakers and major switchgear components. Maintenance and testing accessories shall include, but are not limited to the following:

a. Portable gear motor for electric-power positioning of circuit breakers, if required by the breaker design.

b. Secondary test coupler for testing of drawout circuit breakers in the test position.

c. Hand crank for positioning of circuit breakers.

d. Transfer truck, for movement of circuit breaker units.

e. Test cabinet for closing and tripping of circuit breakers by electrical control operations.

f. Lifting and transfer device for two-high circuit breaker units.

2.3.6.14 Finish Color

Finish color of the switchgear shall comply with the requirements for cabinets specified in paragraph CABINETS AND ENCLOSURES.

2.3.7 Instrument Transformers

2.3.7.1 General

Instrument transformers shall comply with NEMA/ANSI C12.11 and IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on drawings.

2.3.7.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. The continuous thermal-current rating factor shall be not less than [1.0] [1.2] [1.5] [2.0] [3.0] [4.0]. Other thermal and mechanical ratings of current transformers and their primary leads shall be coordinated with the design of the circuit breaker and shall be not less than the momentary rating of the associated circuit breaker. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accidental open-circuiting of the transformers while energized. Each terminal of each current transformer shall be connected to a short-circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.3.7.2.1 Current Transformers for Power Transformers

[Single-ratio] [Multi-ratio] bushing type current transformers shall be provided in circuit breaker bushing wells as indicated. [Single-ratio units shall have a minimum metering accuracy class rating of [0.6B-0.5] [0.3B-0.5].] [Multi-ratio units shall have a minimum relaying accuracy voltage class of [_____] for either a C or T classification.]

2.3.7.2.2 Current Transformers for Metal-Clad Switchgear

Single-ratio units, used for metering and relaying, shall have a metering accuracy class rating of [_____] [B.____]. Single-ratio units, used only for relaying, shall have a relaying accuracy class rating of [_____] for [either] a C [or T] classification.

2.3.7.2.3 Current Transformers for Kilowatthour and Demand Metering

Current transformers shall conform to IEEE C57.13. Provide current transformers with a metering accuracy Class of 0.3 through [_____], with a minimum RF of [_____] at 30 degrees C, with 600-volt insulation, and 10 kV BIL. Size current transformers as indicated. Provide butyl-molded window type current transformers mounted [on the transformer low-voltage bushings. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on ammeters.] [in the current transformer cabinet.]

2.3.7.3 Voltage Transformers

Voltage transformers shall have indicated ratios. Units shall have an accuracy class rating of [_____]. Voltage transformers shall be of the drawout type having current-limiting fuses in both primary and secondary circuits. Mechanical interlocks shall prevent removal of fuses, unless the associated voltage transformer is in a drawout position. Voltage transformer compartments shall have hinged doors.

2.3.8 Auxiliary Substation Equipment

2.3.8.1 Voltage Regulator

Voltage regulators shall comply with IEEE C57.15 and shall be of the outdoor, self-cooled, 55/65 degrees C temperature rise, [single-phase] [three-phase] station-type. Two single-phase units connected in open-delta are not acceptable. Windings and the load-tap-changing mechanism shall be mineral-oil-immersed. When operating under load, a regulator shall provide plus and minus 10 percent automatic voltage regulation in approximately 5/8 percent steps, with 16 steps above and 16 steps below rated voltage. Automatic control equipment shall provide Class 1 accuracy. Bypass surge arresters shall be suitable for [a grounded] [an ungrounded] system and for the associated regulator voltage. [Station] [Intermediate] class surge arresters shall be mounted next to each incoming line bushing on a regulator tank-mounted bracket and connected to a surge arrester ground pad-mounted on the regulator tank.

2.3.8.1.1 Ratings

Ratings at 60 Hz	
Maximum voltage	[_____]
BIL	[_____]
Current	[_____]

2.3.8.1.2 Bypass and Isolation Switches

Switches shall be of the outdoor, stick-operated, single-pole, single-throw, vertical-break type suitable for the indicted mounting. One switch stick of adequate length shall be provided. Switches shall be of a type designed to provide bypass of a single-phase regulator circuit by an integral sequence which always occurs when each switch is opened or closed. Each opening sequence shall initially bypass the single-phase

regulator circuit, then open the input and output circuits, and finally interrupt the exciting current. Opening any single-phase regulator circuit shall not be possible until after the bypass circuit is closed. Unless the voltage regulator is equipped with integral line surge protective devices, [surge protectors shall be mounted across terminals of each switch rated up to 25 kV.] [station-class surge arresters shall be provided to protect each phase of 35 kV switches.] Ratings at 60 Hz shall be in accordance with IEEE C37.41 and as follows:

Maximum voltage	[_____]
Nominal voltage class	[_____]
BIL	[_____]
Momentary asymmetrical current in the closed position	[_____]
Momentary asymmetrical current in the bypass position	[_____]
Continuous and interrupting current	[_____]

2.3.8.1.3 Miscellaneous

Standard accessories and components in accordance with IEEE C57.15 shall be provided. The regulator subbase shall elevate the lowest live part of the regulator to a height of at least 9 feet above the concrete pad on which it is mounted. Single-phase units shall be provided with additional components and accessories required by IEEE C57.15 for three-phase units.

2.3.8.2 Station Battery

The station battery installation shall include a battery, battery racks, a battery charger, and protective equipment. The station battery installation shall be housed [in the metal-clad switchgear] [where indicated].

2.3.8.2.1 Battery

Submit calculations for the battery and associated charger indicating the basis used in defining loads, selecting cell types, and determining the battery ampere-hour capacity and physical size. Provide calculations to determine capacity for the battery charger to be similar to those shown in the Appendix to IEEE 485, including explanatory data. Calculations for the battery-charger shall demonstrate that the output voltage and current provided are adequate to comply with the preceding requirements. The battery shall consist of the required number of [lead-calcium] [nickel-cadmium] cells interconnected with proper connectors provided by the battery manufacturer to provide a nominal battery rating of [48] [125] volts. Rubber or plastic numerals, of at least 1 inch in height, shall be provided by the battery manufacturer for field attachment to permit proper cell identification. The battery shall have an ampere-hour capacity equal to at least 125 percent of the station's direct-current requirements including normal continuous loads plus intermittent loads. Normal continuous load capacity shall be adequate for an [8-hour] [_____] period. Intermittent load capacity shall be adequate so that at least [three] [_____] openings and [three] [_____] closings of each of the station's

associated circuit breakers [and motor-operated] [switches] can occur in [an 8-hour] [_____] period with no more than [three] [_____] circuit breaker [or switch] units simultaneously operating. Battery circuits shall be ungrounded. Batteries shall have a 20-year minimum life and a 5-year no cost replacement warranty.

2.3.8.2.2 Battery Racks

Battery racks shall have welded steel frames and rails finished with two coats of paint of a color matching the battery charger enclosure. Racks shall be no more than two tiers high and top tiers shall be low enough to permit maintenance to be done by personnel standing at floor level. Rails shall have a top covering of plastic or rubber at least 1/16 inch thick. Paint, rubber, and plastic shall resist corrosion and action of the electrolyte. The installation shall be provided with a portable hydrometer syringe and thermometer. Where recommended by the manufacturer, the installation shall include a cell lifter.

2.3.8.2.3 Battery Charger

The battery charger shall comply with UL 1236 and shall be a constant voltage, filtered, voltage-regulated, fully automatic type rated for full-float charging of the associated battery. The battery charger shall be convection cooled and suitable for operation on electric power supplied from the associated low-voltage alternating-current panelboard, shall have adequate capacity to fully recharge the associated depleted battery in not more than [8 hours] [_____] while supplying normal direct-current loads, and shall have an efficiency of not less than 90 percent. The battery charger shall have input and output circuit breakers which automatically disconnect the battery charger when faults occur. The battery charger shall have an output ammeter and voltmeter, and equalizing-float selector switch, and an equalizing timer with a range of 0 to 24 hours. The battery charger enclosure shall be painted as specified for indoor cabinets in paragraph CABINETS AND ENCLOSURES and shall be provided with wall mounting brackets or shall be free-standing as required by its size and weight. A relay for sensing loss of alternating-current input, and an adjustable relay for sensing that the battery charger output voltage has fallen to a pre-set level, shall be installed on the battery charger to actuate the associated annunciator circuits. DC ground detector LED lights shall be provided.

2.3.8.2.4 Protective Equipment

Protective equipment required by IEEE 484 shall be provided and installed in a free-standing cabinet mounted where indicated or directed. The cabinet shall conform to paragraph CABINETS AND ENCLOSURES. Water facilities required shall be of the portable type consisting of one 5 gallon tank and one 1 quart basin. The tank shall have a removable screw top and a spigot. The basin shall be suitable for rinsing eyes or skin in case of acid spillage.

2.3.8.3 Illumination

Luminaires, ballasts, lamps, and control devices required for [general area] [and] [_____] lighting [, including floodlighting] shall be in accordance with sheet [_____] sheets [_____] of Standard Detail No. 40-06-04, attached to these specifications.

2.3.8.4 Annunciator System

The annunciator system shall consist of the station's audible [and visual] indicator and an annunciator cabinet. The cabinet shall house an annunciator drop for each component malfunction indicated plus a system pushbutton and flasher and shall be located in [the metal-clad switchgear aisle] [where indicated]. [[_____] spare drops shall be included.] Electrical devices required shall be rated for the application and shall be suitable for the low-voltage alternating-current available as shown or specified. Auxiliary devices shall be provided as necessary for correct operation.

2.3.8.4.1 Station Audible and Visual Indication

One station horn [and the indicated number of station red alarm lights] shall be installed where shown. The station horn shall be weatherproof and shall be of the resonating type having an audible output of not less than 100 dB at 10 feet. Station lights shall be 25-watt incandescent with guards and red globes, shall be UL listed as enclosed and gasketed for use in wet locations, and shall be of a style suitable for the indicated mounting. A horn silencing relay shall be wired in series with the horn so that, after an adjustable time delay of 5 to 15 minutes, the horn shall be silenced. Necessary auxiliary devices provided in conjunction with the horn shall permit signaling to a remote central point.

2.3.8.4.2 Operating Modes

The system shall be wired so that when the component being monitored by an annunciator is operating correctly, the associated annunciator relay actuates the normal mode, and when the component malfunctions, the associated annunciator relay actuates the alert mode. During normal mode no part of the system shall be energized by the associated annunciator relay. Upon equipment malfunction, the alert mode shall energize the system flasher which shall turn the associated annunciators lights on and off, and sound the station horn, including turning on the station exterior visual indication lights. Depressing the station pushbutton shall turn off the horn, the station visual indication lights, and the flasher, but shall leave the associated annunciator lights on. Correction of a malfunction shall automatically return the alarm system to the normal mode for the associated annunciator relay. Turning the system pushbutton during a normal mode shall simulate an alert mode for all annunciator relays so that correct operation of annunciator lamps, the station exterior visual indication lights, the system flasher, and the station horn can be checked.

2.3.8.4.3 Annunciators

Annunciators shall comply with ISA 18.1 and shall be solid-state logic, modular, hermetically sealed, plug-in relays each with two integral long-life lamps for backlighting a white translucent nameplate window of not less than 3 by 3 inches. Nameplates shall have black letters at least 1/8 inch in height and the inscription shall match the indicated malfunction description.

2.3.8.4.4 Other Requirements

The annunciator cabinet shall be suitable for the indicated location and shall conform to requirements specified herein for cabinets. The flasher frequency shall be between 1 and 5 Hz. The system pushbutton shall be

provided with a nameplate inscribed "PUSH TO SILENCE" and "TURN TO TEST."

2.3.9 Cabinets And Enclosures

Cabinets and enclosures shall comply with NEMA 250 and shall be of galvanized steel, shall be provided with hinged doors, and shall be suitable for indoor or outdoor installation as indicated. Where locations are not indicated, cabinets shall be suitable for outdoor installation. Thickness of metal and outdoor construction shall be in accordance with UL 50. An indoor cabinet exterior shall have one finish coat and an outdoor cabinet exterior shall have two finish coats. Finish colors shall be manufacturer's standard dark gray or sky gray for outdoor cabinets and light gray for indoor cabinets, unless otherwise specified. The finish color of outdoor equipment shall be the same unless otherwise approved. Finish coats shall be applied over a prepared substrate. Each cabinet shall be a freestanding type or may be supported by attachment to an enclosure fence or a switchgear interior wall where located adjacent thereto. A concrete pad shall be provided to support any outdoor cabinet whose base extends to within 3 inches of grade level and pads shall extend at least 4 inches below grade.

2.3.10 Miscellaneous

2.3.10.1 Duplex Receptacles

Duplex receptacles shall be ivory in color and provided where shown. Receptacles exposed to the weather shall be equipped with weatherproof covers or installed in weatherproof box with a hinged door or cover. Receptacles shall be of the ground fault circuit interrupter type, or the receptacles and receptacle circuits shall be protected by a ground fault circuit interrupter type of circuit breaker. Unless otherwise shown, receptacles shall conform to the NEMA WD 1 configuration 5-15R rated at 125 volts, 15 amperes and shall be the two-pole, three-wire grounding type. Wiring for outdoor receptacle circuits shall be not less than No. 12 AWG in size and suitable for installation in wet locations.

2.3.10.2 Low-Voltage Power Circuit Breakers

2.3.10.2.1 Power Circuit Breakers

2.3.10.2.1.1 Construction

Low-voltage power circuit breakers shall conform to IEEE C37.13, and IEEE C37.16, and shall be three-pole, single-throw, stored energy, [manually][electrically] operated, with drawout mounting. Solid-state trip elements which require no external power connections shall be provided. Circuit breakers shall have an open/close contact position indicator, charged/discharged stored energy indicator, primary disconnect devices, and a mechanical interlock to prevent making or breaking contact of the primary disconnects when the circuit breaker is closed. Control voltage shall be [24 V dc][48 V dc][125 V dc][120 V dc][as indicated]. The circuit breaker enclosure shall be suitable for its intended location.

2.3.10.2.1.2 Ratings

Voltage-ratings shall be not less than the applicable circuit voltage. Circuit breakers shall be rated for 100 percent continuous duty and shall have trip current ratings and frame sizes as shown. Nominal voltage ratings, maximum short-circuit interrupting ratings shall be in accordance

with IEEE C37.16. Tripping features shall be as follows:

a. Long-time current pick-up, adjustable from 50 percent to 100 percent of sensor current rating.

b. Adjustable long-time delay.

c. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

d. Adjustable short-time delay.

[e. Short-time I square times t switch.]

[e][f]. Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.

[f][g]. Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but in no case greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap shall not be permitted. [Zone-selective interlocking shall be provided as indicated.]

[g][h]. [Fixed] [Adjustable] ground-fault delay.

[[h][i]. Ground-fault I square time t switch.]

[h][i][j]. [Overload] [and] [Short-circuit] [and] [Ground-fault] trip indicators shall be provided.

2.3.10.2.2 Molded-Case Circuit Breakers

UL 489 and UL 489.

2.3.10.3 Wiring

Wiring between separate items of station equipment shall conform to the requirements of Section [33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION] [33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION]. Solid wiring may be used for convenience outlets, heating elements, and lighting circuits. Otherwise, the minimum class of stranding shall be Class C. Class K stranding shall be used for wiring between items of equipment mounted on swinging panels or doors and items mounted on fixed panels or parts of fixed assemblies. The insulation type shall be the type SIS unless otherwise specified, indicated, or proposed and approved for use. The minimum wire gauge shall be No. 14 AWG, except No. 18 AWG may be used for circuits that use one ampere or less. Circuits rated less than 115 volts ac or 125 volts dc may be wired with wiring rated 300 volts-to-ground. Otherwise, all wiring shall be rated for 600 volts ac and 250 volts dc Current transformer circuit wiring shall be not less than No. 10 AWG. Wiring for Close and Trip circuits shall be not less than No. 8 AWG. Wire markers shall be affixed to each end of wires and shall contain wire number or designations shown on contract or detail drawings, or as otherwise approved. Wire numbers shall also be permanently marked on terminal block marking strips where wires are connected. Only insulated-barrel, crimp-type, ring lugs shall be used.

2.3.10.4 Single-Line Electrical Diagram

A single-line electrical diagram of the station shall be provided. The diagram shall be enclosed between matte-surface thermoplastic sheets buttoned or otherwise suitably fastened together to allow easy access to the diagram for making any future changes. The diagram shall be suitable for outdoor mounting and shall be approximately 14 by 21 inches unless another size is approved. The diagram shall be attached with temperature- and moisture-resistant, pressure-sensitive adhesive or with other suitable means to the indicated location at the metal-clad switchgear lineup, except when otherwise shown or directed.

2.3.10.5 Liquid Dielectrics

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 Trichlorobenzene (TCB) fluid shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 50 parts-per-million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D923 and have tests performed in accordance with ASTM D4059at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 50 ppm shall be replaced.

2.3.10.6 Danger Signs

One danger sign inscribed "DANGER-HIGH VOLTAGE" shall be permanently and securely mounted approximately 5 feet above finished grade on each outward side of the fence enclosure. Fasteners shall be of stainless steel. Signs shall be of metal and shall have letters of at least 3 inches in height. Voltage warning signs shall comply with IEEE C2.

2.3.10.7 Concentric-Lay-Stranded Conductors

Copper conductors shall comply with ASTM B8 for soft drawn copper. Equivalent aluminum conductors shall comply with ASTM B231/B231M.

2.3.10.8 Conduits, Rigid Metal

Conduits shall comply with UL 6.

2.3.10.9 Hardware

Ferrous metal threaded items shall comply with ASTM A153/A153M and miscellaneous nonthreaded items shall comply with ASTM A123/A123M. Other equivalent protective treatment, as required by ASTM A123/A123M or ASTM A153/A153M, or ferrous metals designed to meet ASTM Standards covering corrosion-resisting steel, will be permitted if approved in writing.

2.3.10.10 Padlocks

Padlocks shall comply with Section 08 71 00 DOOR HARDWARE

2.3.10.11 Panelboards, Circuit-Breaker Type

Panelboards shall comply with NEMA PB 1, UL 50 and UL 67.

2.3.11 Grounding And Bonding

2.3.11.1 Driven Ground Rods

Ground rods shall be [copper-clad steel conforming to UL 467] [zinc-coated steel conforming to IEEE C135.30] [solid stainless steel] not less than 5/8 inch in diameter by 10 feet in length [of the sectional type].

2.3.11.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as the phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.3.12 Surge Arresters

Surge arresters shall comply with NEMA LA 1, and IEEE C62.11, and shall be provided as indicated. Arresters shall be [station][intermediate][distribution] class, rated as shown.[Arresters for use at elevations in excess of 6000 feet above mean sea level shall be specifically rated for that purpose.] Arresters shall be equipped with mounting brackets for the indicated installations. Arresters shall be of the [valve][or][metal-oxide varistor][or][combination valve-metal-oxide varistor] type suitable for outdoor installations.

2.3.13 Coordinated Power System Protection

Analyses shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for equipment ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and a protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. Provide a list of references complete with points of contact, addresses, and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.3.13.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: [the source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.] [the source bus and extended through the secondary side of transformers for medium voltage distribution feeders.] [the source bus and extend through [outgoing breakers] [outgoing medium voltage feeders, down to the individual protective devices for medium voltage radial taps] [outgoing medium voltage feeders, through the secondary side of transformers] for main electric supply substations.] [the nearest upstream device in the existing source system and extend through the downstream devices at the load end.]

2.3.13.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. Coordinate with PREPA for fault current availability at the site.

2.3.13.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device, or transformation point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.3.13.4 Fault Current Analysis

2.3.13.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE 242, and IEEE 399.

2.3.13.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

2.3.13.4.3 Fault Current Availability

Balanced three-phase fault, bolted line-to-line, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.

2.3.14 Factory Tests

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications.

2.3.14.1 Power Transformer

Manufacturer's standard routine tests in accordance with IEEE C57.12.00. Reduce full-wave, chopped-wave, and full-wave impulse test on each line [and neutral] terminal, in accordance with IEEE C57.98. Tests for transformer losses in accordance with IEEE C57.12.90.

2.3.14.2 High-Voltage Circuit Breakers

Manufacturer's standard tests in accordance with IEEE C37.09 and IEEE C37.081.

2.3.14.3 High-Voltage Air Switches

Manufacturer's standard tests in accordance with IEEE C37.34 and IEEE C37.41.

2.3.14.4 Protective Relays

Seismic tests in accordance with IEC 60255-21-3. Surge withstand tests in accordance with IEEE C37.90.1.

2.3.14.5 Relaying Current Transformers

Manufacturer's standard tests in accordance with IEEE C57.13.

2.3.14.6 Instrument Current Transformers

Manufacturer's standard tests in accordance with IEEE C57.13.

2.3.14.7 Voltage Regulators

Manufacturer's standard tests in accordance with IEEE C57.15.

2.3.14.8 High-Voltage Fuses

Manufacturer's standard tests in accordance with IEEE C37.41.

2.3.14.9 Neutral Grounding Resistor

Manufacturer's standard tests in accordance with IEEE 32.

2.3.14.10 Electrical Power Insulators

Manufacturer's standard tests in accordance with ANSI C29.1.

2.4 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 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 --

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Repair and Restoration of Electric Power Grid in Puerto Rico

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	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 35 26	SD-01 Preconstruction Submittals															
			Accident Prevention Plan (APP)	1.7	G													
			SD-06 Test Reports															
			Monthly Exposure Reports	1.4														
			Notifications and Reports	1.11														
			Accident Reports	1.11.2	G													
			SD-07 Certificates															
			Crane Operators/Riggers	1.6.1.4														
			Standard Lift Plan	1.7.2.2	G													
			Critical Lift Plan	1.7.2.3	G													
			Naval Architecture Analysis	1.7.2.4	G													
			Activity Hazard Analysis (AHA)	1.8														
			Certificate of Compliance	1.11.3														