SECTION 26 05 13

MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Section, apply to this Section.

1.02 SUMMARY

A. This Section includes cables, splices, terminations, and accessories for medium-voltage electrical distribution systems.

1.03 SUBMITTALS

A. Product Data: For each type of cable, splice and termination.

B. Field quality-control test reports.

1.04 QUALITY ASSURANCE

A. Installer: Engage a cable splice, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable.

B. Source Limitations: Obtain cables and accessories through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with IEEE C2 and NFPA 70.

1.05 PROJECT CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than 14 days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cables:

a. Southwire Company.
b. Kerite Co. (The); Hubbell Incorporated.
c. Okonite Company (The).
d. Pirelli Cables & Systems NA.
e. Rome Cable Corporation.

2. Cable Splicing and Terminating Products and Accessories:

a. Raychem Corp.; Telephone Energy and Industrial Division.
b. RTE Components; Cooper Power Systems, Inc.
c. Scott Fetzer Co. (The); Adalet, Inc.
d. 3M Company; Electrical Products Division.

2.02 CABLES

A. Cable Type: **MV105**, with **aluminum** conductor and **compact round, concentric lay, class B or Concentric lay, Class B** stranding.

B. Comply with UL-1072, AEIC CS8, and applicable sections of ICEA.

C. Strand Filling: Conductor interstices are filled with impermeable compound.

D. Conductor Insulation: Ethylene-propylene rubber.

1. Voltage Rating: **15** kV.
2. Insulation Thickness: **133** percent insulation level.

E. Shielding: **Copper tape** or **Solid copper wires**, helically applied over semiconducting insulation shield.

F. Shielding and Jacket: Corrugated copper drain wires embedded in extruded, chlorinated, polyethylene jacket.

G. Cable Jacket: **Sunlight-resistant PVC**.

2.03 SPLICE KITS

A. Splice Kits: Comply with IEEE 404; type as recommended by cable or splicing kit manufacturer for the application.

B. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions.

1. Heat-shrink splicing kit, polymeric construction with outer heat-shrink jacket.
2. Premolded, cold-shrink-rubber, in-line splicing kit.
3. Premolded EPDM splicing body kit with cable joint sealed by interference fit of mating parts and cable.

2.04 SOLID TERMINATIONS

A. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class is equivalent to that of cable. Include shield ground strap for shielded cable terminations.

1. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone rubber, insulator modules; shield ground strap; and compression-type connector.
2. Class 1 Terminations: Heat-shrink type with heat-shrink inner stress control and outer nontracking tubes; multiple, molded, nontracking skirt modules; and compression-type connector.
3. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief shield terminator; multiple-wet-process, porcelain, insulator modules; shield ground strap; and compression-type connector.
4. Class 1 Terminations, Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, compression-type connector, and end seal.
5. Class 2 Terminations, Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, and compression-type connector. Include silicone-rubber tape, cold-shrink-rubber sleeve, or heat-shrink plastic-sleeve moisture seal for end of insulation whether or not supplied with kits.
6. Class 3 Terminations: Kit with stress cone and compression-type connector.

2.05 SEPARABLE INSULATED CONNECTORS

A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.

B. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.

C. Load-Break Cable Terminators: Elbow-type units with 200-A load make/break and continuous-current rating. **Include test point on terminator body that is capacitance coupled.**

D. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, manufacturer's standard accessory stands, stainless-steel mounting brackets, and attaching hardware.

1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.
2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.

E. Test-Point Fault Indicators: Applicable current-trip ratings and arranged for installation in test points of load-break separable connectors, and complete with self-resetting indicators capable of being installed with shotgun hot stick and tested with test tool.

F. Tool Set: Provide Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

2.06 SOURCE QUALITY CONTROL

A. Test and inspect cables according to ICEA before shipping.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install cables according to IEEE 576.

B. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

D. Support cables according to Division 26 Section "Common Work Results for Electrical."

E. Install direct-buried cables on leveled and tamped bed of 3-inch thick, clean sand. Separate cables crossing other cables or piping by a minimum of 4 inches of tamped earth.

1. Install permanent markers at ends of cable runs, changes in direction, and buried splices.
2. Install "buried-cable" warning tape 12 inches (305 mm) above cables.

F. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit.

G. Install cable splices at pull points and elsewhere as indicated; use standard kits.

H. Install separable insulated-connector components as follows:

1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
2. Portable Feed-Through Accessory: Three.
3. Standoff Insulator: Three.

I. Seal around cables passing through fire-rated elements according to Division 07 Section "Penetration Firestopping."

J. Ground shields of shielded cable at terminations, splices, and separable insulated connectors.

K. Identify cables according to Division 26 Section "Identification for Electrical Systems."

3.02 FIELD QUALITY CONTROL

A. Testing of all primary cables will be by an independent testing company under a subcontract to the electrical contractor. The Electrical Contractor shall provide assistance as required during these tests.

B. All primary distribution voltage cables shall be given a D.C. high potential test prior to all permanent connections being made.

C. Cable continuity and phase identification shall be checked.

D. Cables shall not be subjected to more than one high potential test with approval of Owner's Representative. Successive tests shall be at voltages per instructions from the Owner's Representatives.

E. During all tests a man shall be stationed at each point where the cable is exposed.

F. The D.C. high potential test voltage to be applied shall be 80% of manufacturers acceptance voltage test, applied in incremental steps and for such duration as specified by the Owner's Representative until the 80% value is reached; then the 80% value shall be held for fifteen minutes. The test voltage should be applied gradually during the first minute with initial application being not greater than the rated voltage of the cable.

G. During high potential tests, leakage current readings shall be taken at thirty second intervals during the first two minutes of the test and at one minute intervals during the remainder of the test. If, after the first minute, the leakage current increases, the Owner's Representative may elect to stop the test. Further test will be made at his discretion only. No test will be accepted where there is a continual increase in leakage current throughout the test. The cable must withstand the specified high voltage without breakdown. If a second test is necessary, it must similarly withstand the voltage specified by the Owner's Representative.

The test record shall include the following:

1. Complete identification of cable, including approximate length.

2. High potential value, leakage current value, and time data.

3. The approximate average cable temperature.

4. High potential versus leakage current plot.

H. No cable shall be energized until these tests are approved by the Owner's Representative.

END OF SECTION

SECTION 26 12 00

MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following types of transformers with medium-voltage primaries:
   1. Dry-type distribution and power transformers.

1.03 DEFINITIONS

A. NETA ATS: Acceptance Testing Specification.

1.04 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, location of each field connection, and performance for each type and size of transformer indicated.

B. Shop Drawings: Diagram power signal and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that transformer assembly and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems" Include the following:

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For testing agency.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Follow-up service reports.

H. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of transformers and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with IEEE C2.

E. Comply with ANSI C57.12.10, ANSI C57.12.28, IEEE C57.12.70, and IEEE C57.12.80.

F. Comply with NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store transformers[**protected from weather and**] so condensation will not form on or in units. Provide temporary heating according to manufacturer's written instructions.

1.07 PROJECT CONDITIONS

A. Service Conditions: IEEE C37.121, usual service conditions except for the following:

1. Exposure to significant solar radiation.
2. Altitudes above 3300 feet (1000 m).
3. Exposure to fumes, vapors, or dust.
4. Exposure to explosive environments.

5. Exposure to hot and humid climate or to excessive moisture, including steam, salt spray, and dripping water.
6. Exposure to seismic shock or to abnormal vibration, shock, or tilting.
7. Exposure to excessively high or low temperatures.
8. Unusual transportation or storage conditions.
9. Unusual grounding-resistance conditions.
10. Unusual space limitations.

1.08 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of louvers, doors, spill retention areas, and sumps. Coordinate installation so no piping or conduits are installed in space allocated for medium-voltage transformers except those directly associated with transformers.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton/Cooper Industries; Cooper Power Systems Division.
2. Cutler-Hammer.
3. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
4. GE Electrical Distribution & Control/ABB.
5. Siemens Energy & Automation, Inc.
6. Square D; Schneider Electric.

2.02 DRY-TYPE DISTRIBUTION AND POWER TRANSFORMERS

A. Description: NEMA ST 20, IEEE C57.12.01, **UL 1562 listed and labeled**, dry-type, 2-winding transformers.

1. **Indoor, ventilated**, cast coil/encapsulated coil, with primary and secondary windings individually cast in epoxy; with insulation system rated at 185 deg C with an 80 deg C average winding temperature rise above a maximum ambient temperature of 40 deg C.

B. Primary Connection: Air terminal compartment with **removable** door. Tin-plated copper bar for incoming line termination, predrilled to accept terminals for indicated conductors.

C. Primary Connection: Transition terminal compartment with connection pattern to match switchgear.

D. Secondary Connection: Air terminal compartment with **removable** door. Tin-plated copper bar for incoming line termination, predrilled to accept terminals for indicated conductors.

E. Secondary Connection: Transition terminal compartment with connection pattern to match **bus duct**.

F. Insulation Materials: IEEE C57.12.01, rated at 220 deg C.

G. Insulation Temperature Rise: **115** deg C, maximum rise above 40 deg C.

H. Basic Impulse Level: **60** kV.

I. Full-Capacity Voltage Taps: Four nominal 2.5 percent taps, 2 above and 2 below rated primary voltage.

J. Full-Capacity Voltage Taps: Four nominal 2.5 percent taps below rated primary voltage.

K. Cooling System: Class **AA, self-cooled**, complying with IEEE C57.12.01.

1. Automatic forced-air cooling system controls, including thermal sensors, fans, control wiring, temperature controller with test switch, power panel with current-limiting fuses, indicating lights, alarm, and alarm silencing relay.
2. Include mounting provision for fans.

L. Sound level may not exceed **<Insert acceptable dBA level> sound levels listed in NEMA TR 1**, without fans operating.

M. High-Temperature Alarm: Sensor at transformer with local audible and visual alarm and contacts for remote alarm.

2.03 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.04 SOURCE QUALITY CONTROL

A. Factory Tests: Perform design and routine tests according to standards specified for components. Conduct transformer tests according to **ANSI C57.12.50**.

B. Factory Tests: Perform the following factory-certified tests on each transformer:

1. Resistance measurements of all windings on rated-voltage connection and on tap extreme connections.
2. Ratios on rated-voltage connection and on tap extreme connections.
3. Polarity and phase relation on rated-voltage connection.
4. No-load loss at rated voltage on rated-voltage connection.
5. Excitation current at rated voltage on rated-voltage connection.
6. Impedance and load loss at rated current on rated-voltage connection and on tap extreme connections.
7. Applied potential.
8. Induced potential.

9. Temperature Test: If transformer is supplied with auxiliary cooling equipment to provide more than one rating, test at lowest kilovolt-ampere Class OA or Class AA rating and highest kilovolt-ampere Class OA/FA or Class AA/FA rating.

   a. Temperature test is not required if record of temperature test on an essentially duplicate unit is available.

10. Owner will witness all required factory tests. Notify Architect at least 14 days before date of tests and indicate their approximate duration.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions for compliance with requirements for medium-voltage transformers.

B. Examine roughing-in of conduits and grounding systems to verify the following:

1. Wiring entries comply with layout requirements.
2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and that requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install transformers on concrete bases.

1. Anchor transformers to concrete bases according to manufacturer's written instructions, seismic codes at Project, and requirements in Division 26 Section "Hangers and Supports for Electrical Systems."
2. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit and 4 inches high.
3. Use **3000-psi**, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "**Cast-in-Place Concrete**."
4. Install dowel rods to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
5. Install epoxy-coated anchor bolts, for supported equipment, that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

7. Tack-weld or bolt transformers to channel-iron sills embedded in concrete bases. Install sills level and grout flush with floor or base.

B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

3.03 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

3.04 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect**, test, and adjust** field-assembled components and equipment installation, including connections**, and to assist in field testing**. Report results in writing.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

D. Perform the following field tests and inspections and prepare test reports:

1. After installing transformers but before primary is energized, verify that grounding system at substation is tested at specified value or less.
2. After installing transformers and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Remove and replace malfunctioning units and retest as specified above.

F. Test Reports: Prepare written reports to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective actions taken to achieve compliance with requirements.

3.06 FOLLOW-UP SERVICE

A. Voltage Monitoring and Adjusting: If requested by Owner, perform the following voltage monitoring after Substantial Completion but not more than six months after Final Acceptance:

1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at secondary terminals of each transformer. Use voltmeters with calibration traceable to National Institute of Science and Technology standards and with a chart speed of not less than 1 inch (25 mm) per hour. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from nominal value by more than plus or minus 5 percent during test period, is unacceptable.
2. Corrective Actions: If test results are unacceptable, perform the following corrective actions, as appropriate:

    a. Adjust transformer taps.
    b. Prepare written request for voltage adjustment by electric utility.

3. Retests: After corrective actions have been performed, repeat monitoring until satisfactory results are obtained.
4. Report: Prepare written report covering monitoring and corrective actions performed.

B. Infrared Scanning: Perform as specified in Division 26 Section "Medium-Voltage Switchgear."

END OF SECTION

SECTION 26 13 00

MEDIUM-VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes metal-clad, circuit-breaker switchgear with the following optional components, features, and accessories:

1. Copper, silver-plated main bus at connection points
2. Communication modules.
3. Digital metering and instruments.
4. Relays.
5. Surge arresters.
6. Provisions for future devices
7. Control battery system.
8. Mimic bus.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. GFCI: Ground-Fault Circuit Interrupter.

1.4 SUBMITTALS

A. Product Data: For each type of switchgear and related equipment, include the following:

1. Rated capacities, operating characteristics, furnished specialties, and accessories for individual circuit breakers
2. Time-current characteristic curves for overcurrent protective devices, including circuit-breaker relay trip devices.

B. Shop Drawings: For each type of switchgear and related equipment, include the following:

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show method of field assembly and location and size of each field connection. Include the following:

a. Tabulation of installed devices with features and ratings.

b. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
c. Drawing of cable termination compartments showing preferred locations for conduits and indicating space available for cable terminations.
d. Floor plan drawing showing locations for anchor bolts and leveling channels.
e. Current ratings of buses.
f. Short-time and short-circuit ratings of switchgear assembly.
g. Nameplate legends.
h. Mimic-bus diagram.

i. Utility company's metering provisions with indication of approval by utility company.

2. Wiring Diagrams: For each type of switchgear and related equipment, include the following:

a. Power, signal, and control wiring.
b. Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.
c. Schematic control diagrams.
d. Diagrams showing connections of component devices and equipment.
e. Schematic diagrams showing connections to remote devices.

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where piping and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Identify field measurements.

D. Operation and Maintenance Data: For switchgear and switchgear components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain each type of switchgear and associated components through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with IEEE C2.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver in sections of lengths that can be moved past obstructions in delivery path as indicated.

B. Store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. If stored in areas subjected to weather, cover switchgear to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchgear; install electric heating (250 W per section) to prevent condensation.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation at indicated ampere ratings for the following conditions:

1. Ambient temperature not exceeding 122 deg F
2. Altitude of 1000 above sea level.

B. Installation Pathway: Remove and replace building components and structures to provide pathway for moving switchgear into place.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchgear, including clearances between switchgear and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.8 COORDINATION

A. Coordinate layout and installation of switchgear and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.

B. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Six of each type and rating used. Include spares for future transformers, control power circuits, and fusible devices.
2. Indicating Lights: Six of each type installed.
3. Touchup Paint: Three containers of paint matching enclosure finish, each 0.5 pint

B. Maintenance Tools: Furnish tools and miscellaneous items required for interrupter switchgear test, inspection, maintenance, and operation. Include the following:

1. Fuse-handling tool.
2. Extension rails, lifting device, transport or dockable dolly or mobile lift, and all other items necessary to remove circuit breaker from housing and transport to remote location.
3. Racking handle to move circuit breaker manually between connected and disconnected positions, and a secondary test coupler to permit testing of circuit breaker without removal from switchgear.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MANUFACTURED UNITS

A. Description: Factory assembled and tested, and complying with IEEE C37.20.1.

B. Ratings: Suitable for application in 3-phase, 60-Hz, solidly grounded-neutral system.

C. System Voltage: 12.47 kV nominal; 15 kV maximum

2.3 METAL-CLAD, CIRCUIT-BREAKER SWITCHGEAR

A. Manufacturers:
1. Powercon Corp
2. General Electric Distribution & Control/ABB.
3. Square D; Schneider Electric.
4. Russelectric, Inc.
5. Eaton/Cooper Power Systems

6. S & C Electric Company

B. Comply with IEEE C37.20.3.

C. Nominal Interrupting-Capacity Class: 500 MVA.

D. Ratings: Comply with IEEE C37.04.

1. Main-Bus Rating: 1200 A, continuous.

E. Circuit Breakers: Three-pole, single-throw, electrically operated, drawout-mounting units using three individual, vacuum-sealed interrupter modules and including the following features:

1. Designed to operate at rated voltage to interrupt fault current within its rating within five cycles of trip initiation. For systems with X/R ratio of 17 or less, transient voltage during interruption shall not exceed twice the rated line-to-ground voltage of the system.
2. Contact-Wear Indicator: Readily accessible to field maintenance personnel.
3. Minimum of six Type A and six Type B spare contacts.
4. Interchangeability: Circuit breakers are interchangeable with vacuum circuit breakers of same current and interrupting ratings.

a. Current rating all Circuit Breakers: 1200 A.

5. Operating Mechanism: Electrically charged, mechanically and electrically trip-free, stored-energy operated.

a. Closing speed of moving contacts to be independent of both control and operator.
b. Design mechanism to permit manual charging and slow closing of contacts for inspection or adjustment.

1) Control Power: 125-V dc for closing and tripping.

c. Provide shunt trip capability independent of overcurrent trip.

F. Main Bus: Copper, silver plated at connection points; full length of switchgear.

G. Ground Bus: Copper, silver plated or copper, tin plated; minimum size 1/4 by 2 inches; full length of switchgear.

H. Bus Insulation: Covered with flame-retardant insulation.

I. Instrument Transformers: Comply with IEEE C57.13.

1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.

2. Current Transformers: Burden and accuracy class suitable for connected relays, meters, and instruments.

J. Relays: Comply with IEEE C37.90, integrated digital type; with test blocks and plugs.

K. Surge Arresters: Distribution class, metal-oxide-varistor type. Comply with NEMA LA 1.

1. Install in cable termination compartments in each phase of circuit.
2. Coordinate rating with circuit voltage.

L. Test Accessories: Relay and meter test plugs.

M. Low-DC-Voltage Alarm: Switchgear shall have a monitor for dc control power voltage with a remote alarm located where indicated. Alarm shall sound if voltage falls to an adjustable value to indicate an impending battery failure. Factory set alarm value at 80 percent of full-charge voltage.

2.4 FABRICATION

A. Exterior Enclosure: Metal clad nema 3R with working vestibule.

B. Finish: Manufacturer's standard gray finish over rust-inhibiting primer on phosphatizing-treated metal surfaces.

C. Bus Transition Unit: Arranged to suit bus and adjacent units.

D. Incoming-Line Unit: Arranged to suit incoming line.

E. Outgoing Feeder Units: Arranged to suit distribution feeders.

F. Provide space heaters and thermostats suitably sized to prevent moisture condensation in each compartment. 120 VAC power to heaters to be from separate customer source.

G. Auxiliary Compartments: Arranged to suit house meters, relays, controls, and auxiliary equipment; isolated from medium-voltage components.

H. Key Interlocks: Arranged to effect interlocking schemes indicated.

I. Provisions for Future Key Interlocks: Mountings and hardware required for future installation of locks, where indicated.

2.5 SWITCHGEAR ARRANGEMENT

A. Switchgear shall contain the following devices and equipment and as shown on the drawings

B. Switchgear Bus

1. 1200 AMP Main circuit breaker module compartment as specified in Section 2.6

2 1200 AMP feeder circuit breaker modules as specified in Section 2.7.

C. Provide allowance for future bus expansion on each end/bus.

D. Provide control power transformers, DC batteries, and charger as specified in Section 2.12.

E. The switchgear general arrangement to be as indicated on the drawings. This layout is the general required arrangement. Actual configuration, section layout, and size to be determined

by the vendor.

2.6 MAIN CIRCUIT BREAKER/SECTION

A. Provide Owner metering equipment and instrumentation compartments as follows:

1. The metering section/auxiliary compartments shall contain three (3) current transformers at 400:5 CT ratio for service side main metering as shown on the drawing.

2. The metering section/auxiliary compartments shall contain three (3) Y-Y voltage transformers (14,400:120) for service side main metering and three (3) Y-Y voltage transformers (14,400:120) for bus metering as shown on the drawing.

a. Provide primary and secondary fusing. Transformers shall be draw-out type, with transformers being disconnected and grounded during movement to the withdrawn position.

C. The circuit breaker shall be rated 12,470 volts, 60 HZ, with a continuous current rating of 1200 amperes and a nominal interrupting rating of 500 MVA.

D. Provide overcurrent devices based on microprocessor technology:

1. Unit shall be SEL (Schweitzer Engineering Laboratories, Inc.) Model SEL-551 Overcurrent Relay (or relay with equivalent functions – see Section 2.18)

E. Provide “utility interconnect protection relay” based on microprocessor technology:

2. Unit shall be SEL (Schweitzer Engineering Laboratories, Inc.) Model SEL-547 Interconnect Protection Relay (or relay with equivalent functions – see Section 2:18)

F. Provide Square D Powerlogic CM-4000 multi-function circuit monitor meter in door of cubicle and wire to CT's and PT's. See the drawings for locations and connections (or unit with equivalent functions – see Section 2:14)

G. The circuit breaker shall be equipped with the following control and pilot devices:

1. Open/close control switch. (See 2.13)

2. Breaker open/close status indicator lights.

3. Breaker open/close auxiliary contacts, two (2) 52a and two (2) 52b contacts per breaker wired to terminal blocks. Note: These contacts are in addition to the status contacts wired for Generator and Paralleling Control and contacts wired to the Circuit Monitor per 2.14

4. Truck Operated Contacts to indicate breaker in “test” and “operate” positions to be wired to terminal blocks

J. Provide lighting arrestors, distribution class, MOV type, 9Kv rms, 7.65 Kv MCOV on the incoming line side of circuit breaker as indicated on the drawings. Arrestor to be Cooper Power Systems UHS or similar.

2.7 FEEDER CIRCUIT BREAKER/SECTION

A.. The circuit breaker shall be rated 12,470 volts, 60 HZ, with a continuous current rating of 1200 amperes and a nominal interrupting rating of 500 MVA.

B. The circuit breaker shall be equipped with the following control and pilot devices:

1. Open/close control switch. (See 2.13)

2. Breaker open/close status indicator lights.

3. Breaker open/close auxiliary contacts, two (2) 52a and two (2) 52b contacts per breaker wired to terminal blocks. Note: These contacts are in addition to the status contacts wired Generator and Paralleling Control.

4. Breaker Housing Switch Contacts to indicate breaker in “test” and “operate” positions to be wired to terminal blocks

C. The circuit breaker shall be equipped with three (3) current transformers. CT sizes are indicated on the drawings

D. Provide overcurrent devices based on microprocessor technology:

1. Unit shall be SEL (Schweitzer Engineering Laboratories, Inc.) Model SEL-551 Overcurrent Relay (or relay with equivalent functions – see Section 2.18)

F. Provide compression type lugs on load-side suitable for connecting 15KV shielded cables, size and quantity as shown on the drawings

G Provide lightning arrestors, distribution class, MOV type, 9kV rms, 7.65 kV MCOV on the load side of circuit breaker as indicated on the drawings. Arrestor to be Cooper Power Systems UHS or similar.

2.10 GENERATOR CIRCUIT BREAKER

A. The circuit breaker shall be rated 12,470 volts, 60 HZ, with a continuous current rating of 1200 amperes and a nominal interrupting rating of 500 MVA.

B. The circuit breaker shall be equipped current transformers as required for generator protection and control.

C. Provide overcurrent devices based on microprocessor technology:

1. Unit shall be SEL (Schweitzer Engineering Laboratories, Inc.) Model SEL-300G Generator Protection Relay (or relay with equivalent functions – see Section 2.18)

D. The generator circuit breaker compartment shall contain three (3) Y-Y voltage transformers (14,400:120) wired to terminals for field connection to generator control system as shown on the drawing.

1. Provide primary and secondary fusing. Transformers shall be draw-out type, with transformers being disconnected and grounded during movement to the withdrawn position.

G. Provide compression type lugs on load-side suitable for connecting 15KV shielded cables, size and quantity as shown on the drawings

C. Provide lightning arrestors, distribution class, MOV type, 18 KV MCOV on the load side of circuit breaker as indicated on the drawings.

H. The circuit breaker shall be equipped with the following control and pilot devices:

1. Breaker open/close status indicator lights.

2. Breaker open/close auxiliary contacts, two (2) 52a and two (2) 52b contacts per breaker wired to terminal blocks. Note: These contacts are in addition to the status contacts wired Generator and Paralleling Control.

3. Truck Operated Contacts to indicate breaker in “test” and “operate” positions to be wired to terminal blocks

4. Open and close initiation for breakers. Remote signal will be dry contact closure.

2.11 LOCAL / REMOTE BREAKER CONTROLS

A. Provide one (1) Selector Switch for each Switchgear lineup to select LOCAL or SYSTEM control for all breakers to function as follows:

1. The local “close” switches to be active only when LOCAL is selected

2. The local “open” switches to be active in both modes

3. The remote “close” signal (contact closure) to be active only when SYSTEM is selected.

4. The remote “open” signal (contact closure) to be active only when SYSTEM is selected.

B. The following functions to be wired to terminal blocks:

1. Open and close initiation for all breakers. Remote signal will be dry contact closure.

2. Status (position) of mode selection switch, dry contact for each position.

2.12 CONTROL POWER

A. Provide one (1) control power transformer for each Bus in each Switchgear lineup, as shown on the drawings, complete with primary and secondary protection.

1. Transformers shall be 15 kVA, 12,470V primary, 120/240 secondary; draw-out type.

2. Provide a circuit breaker protected 120V circuit for power to battery charger.

B. Provide two (2) nickel-cadmium battery systems, complete with chargers.

1. Drawing submittal to include load calculations.

2. Provide mounting rack for batteries, to be installed outside of switchgear. Provide interconnecting “jumpers” between individual batteries.

2. Provide charger to be located outside of switchgear.

3. Provide DC disconnect switches to be located outside switchgear as shown on the drawings.

4. Provide a switching/transfer scheme between the Switchgear DC control bus and an the DC sources (batteries) to automatically connect the DC control bus to an energized source as shown on the drawings Provide the following controls and indicators for transfer system :

a. Manual/Auto selection of source.

b. Indicators to show status of each source, and currently selected source.

c. Remote status monitoring - see Section 2.14.

5. Interconnecting wiring for devices and equipment located outside the switchgear compartments will be by others. This wiring to be included on the Vendor Shop Drawings, including wire sizes.

2.13 CONTROL DEVICES AND WIRING

A. Breaker control switches to be GE type SB or similar by Electroswitch Corporation. (“Open/Close” pushbuttons are not acceptable).

D. Pilot indicating lights to be 125 VDC, LED type, push to test.

E. All control and PT wiring to be type SIS, #14 AWG minimum. All CT wiring to be type SIS, #12 AWG minimum. Low voltage wire terminations (where possible) shall be ring type lugs. All wiring shall be identified at all points of termination.

F. All CT circuits to be provided with shorting terminal blocks, GE type EB or similar.

G. All control fuses shall be installed in pullout fuse blocks. Provide permanent label identifying fuse designation and fuse type and size.

H. Interconnecting wiring between shipping splits shall be provided as a factory assembled harness.

2.14 MULTI-FUNCTION DIGITAL INSTRUMENTATION (MAIN BREAKER)

A. Circuit Monitors shall be Square-D Powerlogic CM-4000, with LCD display, wired for 120 VDC power from DC control bus, with add-in I/O modules as required to meet the following:

1. Monitor status (open/close) of all circuit breakers.

2. Monitor status (DC voltage normal) of DC control buss.

3. Monitor status (AC voltage normal) on AC CPT power source.

4. Monitor status (normal/alarm) of battery chargers.

5. Eight (8) status inputs wired to terminal blocks for Owner's use.

B. Interconnect all circuit monitors with Belden #8723 cable and connect to RS-485 port on master CM-4000 Ethernet Communication Card.

C. Provide one (1) Ethernet Communication Card located in the “master” CM-4000 to provide communication between the circuit monitors via Ethernet.

2.15 OVERCURRENT RELAY COMMUNCIATIONS PROCESSOR

A. Provide one (1) SEL Model 2030 Communications Processor with Ethernet interface

B. All SEL overcurrent relays to be interconnected to this processor.

C. See Section 2.18 substitutes for protective relays.

2.16 EQUIPMENT COMPLETENESS

A. All equipment shall be functionally complete.

B. All equipment shall be completely engineered, fabricated, prewired and ready for installation into an operating condition.

C. Provide the following accessories:

1. Manual racking handle (total of two (2)).

2. Portable breaker lift for installation/removal of circuit breakers (total of one (1)).

2.17 SUBSTITUTES FOR POWER CIRCUIT MONITORS

A. Provide vendor-preferred alternate circuit monitors that are functionally equivalent to the Square D CM4000 and PM-820 units specified. Provide all necessary interface hardware, software, and training as specified herein to provide a complete and functional system.

2.18 SUBSTITUTES FOR PROTECTIVE RELAYS

A. Provide vendor-preferred alternate protective relays that are functionally equivalent to the SEL devices specified. Protective relays shall perform the functions described herein and shall communicate via a network and host software that will allow setting and monitoring of relay functions from a common location. Provide all necessary interface hardware, software, and training as specified herein to provide a complete and functional system.

2.19 IDENTIFICATION

A. Materials: Refer to Division 26 Section "Identification for Electrical Systems." Identify units, devices, controls, and wiring.

B. Mimic Bus: Continuous mimic bus applied to front of switchgear, arranged in single-line diagram format, using symbols and lettered designations consistent with approved final mimic-bus diagram.

1. Mimic-bus segments coordinated with devices in switchgear sections to which applied, to produce a concise visual presentation of principal switchgear components and connections.
2. Medium: Painted graphics, as approved.
3. Color: Contrasting with factory-finish background; selected by Engineer

2.20 SOURCE QUALITY CONTROL

A. Before shipment of equipment, perform the following tests and prepare test reports:

1. Production tests on circuit breakers according to ANSI C37.09.
2. Production tests on completed switchgear assembly according to IEEE C37.20.2.

B. Assemble switchgear and equipment in manufacturer's plant and perform the following:

1. Functional tests of all relays, instruments, meters, and control devices by application of secondary three-phase voltage to voltage circuits and injection of current in current transformer secondary circuits.
2. Functional test of all control and trip circuits. Connect test devices into circuits to simulate operation of controlled remote equipment such as circuit-breaker trip coils, close coils, and auxiliary contacts. Test proper operation of relay targets.

C. Prepare equipment for shipment.

1. Provide suitable crating, blocking, and supports so equipment will withstand expected domestic shipping and handling shocks and vibration.

2. Weatherproof equipment for shipment. Close connection openings to prevent entrance of foreign material during shipment and storage.

2.21 FACTORY FINISHES

A. Finish: Manufacturer's standard color finish applied to equipment before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive switchgear for compliance with requirements for installation tolerances, required clearances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Anchor switchgear assembly to 4-inch, channel-iron sill embedded in concrete base and attach by bolting.

1. Sills: Select to suit switchgear; level and grout flush into concrete base.

2. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for seismic-restraint requirements.

3. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base no less than 3 inches in all directions beyond the maximum dimensions of switchgear, unless otherwise indicated or unless required for seismic anchor support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchgear units and components.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems.".

3.4 CONNECTIONS

A. Cable terminations at switchgear are specified in Division 26 Section "Medium-Voltage Cables."

B. Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque-tightening values.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables" and "Medium-Voltage Cables."

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect switchgear, wiring, components, connections, and equipment installation. Test and adjust components and equipment.
2. Report results in writing.

C. Testing Agency: Contractor shall engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

D. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:

a. Switchgear.
b. Circuit breakers.
c. Protective relays.
d. Instrument transformers.
e. Metering and instrumentation.
f. Ground-fault systems.
g. Battery systems.
h. Surge arresters.
i. Capacitors.

E. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING

A. Set field-adjustable, protective-relay trip characteristics.

3.7 CLEANING

A. On completion of installation, inspect interior and exterior of switchgear. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair damaged finishes.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION