

SECTION 261300 - MEDIUM-VOLTAGE SWITCHGEAR

Latest Update 5-6-2017 See underlined text for Edits.

(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off all "Underlines".)

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 and all other sections of Division 26.

1.2 SUMMARY

- A. This Section includes [metal-enclosed interrupter] [metal-clad, circuit-breaker] **<Insert type>** switchgear with the following optional components, features, and accessories:
 - 1. [Copper, silver-plated main bus at connection points] **<Insert type>** .
 - 2. Communication modules.
 - 3. Relays.
 - 4. Surge arresters.
 - 5. Provisions for future devices.
 - 6. Control battery system.
 - 7. 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 [interrupter switches] [circuit breakers] [interrupter switches and circuit breakers] **<Insert breaker type>**.

2. Time-current characteristic curves for overcurrent protective devices, including [circuit-breaker relay trip] [circuit-breaker relay trip devices] <Insert trip type> 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. Metering provisions with approval by Owner.
 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 including SCADA remote terminal unit.
- 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. Samples: Representative portion of mimic bus with specified finish. Manufacturer's color charts showing colors available for mimic bus.
- E. Qualification Data: For testing agency.

- F. Source quality-control test reports.
- G. Field quality-control test reports.
- H. 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. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
- C. Source Limitations: Obtain each type of switchgear and associated components through one source from a single manufacturer.
- 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.

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°F
 - 2. Altitude of 3300 feet above sea level.
 - 3. <Insert unusual service conditions.>
- 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.
- D. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than 10 days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.

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: Two of each type and rating used. Include spares for future transformers, control power circuits, and fusible devices.
 2. Indicating Lights: Two of each type installed.
 3. Touchup Paint: One container 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. Ground cable, bare copper #4/0, of at least 10'-0" length with clamps at each end.
 3. Linemen's gloves with a minimum 13kV rating.
 4. 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.
 5. 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.
 6. Spare fuse storage cabinet: with piano hinged doors and key lockable. Sized for above listed maintenance tools.

1.10 WARRANTY/GUARANTEE

- A. See Division 26 Specification Section "Basic Electrical Requirements" for warranty and guarantee requirements.

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 (1) 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: 4.16 kV nominal; 4.76 kV maximum or 13.2 kV nominal; 15 kV maximum.

2.3 METAL-ENCLOSED INTERRUPTER SWITCHGEAR

- A. Available Manufacturers:
1. ABB Control, Inc.
 2. Eaton Corporation; Cutler-Hammer Products.
 3. S&C Electric Company.
 4. Square D; Schneider Electric.
- B. Comply with IEEE C37.20.3.
- C. Comply with IEEE C37.20.7. Provide arc-resistant switchgear, Type [1] [2] [1C] [2C] <Insert number> .
- D. Design Level of Available-Source Fault Current: Integrated short-circuit rating consistent with value of fault current indicated.
- E. Ratings: Comply with standard ratings designated in IEEE C37.20.3 for maximum-rated voltage specified.
1. Main-Bus Rating: [600] [1200] [2000] <Insert number> A, continuous.
- F. Interrupter Switches: Stationary, gang operated and suitable for application at maximum short-circuit rating of integrated switchgear assembly.
1. Rating: [600] [1200] <Insert number> -A continuous duty and load break.
 2. Duty-Cycle, Fault Closing: [25,000] [40,000] <Insert number> asymmetrical A.
 3. Switch Action: No external arc and no significant quantities of ionized gas released into the enclosure.
 4. Switch Construction: Supported entirely by interior framework of structure, with copper switchblades and stored-energy operating mechanism.
 5. Phase Barriers: Full length of switchblades and fuses for each pole; designed for easy removal; allow visual inspection of switch components if barrier is in place.
 6. Protective Shields: Cover live components and terminals.
 7. Fuses: De-energized if switch is open.
- G. Mechanical Interlock: Prevent opening switch compartment door unless switchblades are open, and prevent closing switch if door is open.
- H. Window: Permit viewing switchblade positions if door is closed.
- I. Power Fuses: Comply with the following and with applicable requirements in NEMA SG 2:
1. Indicator: Integral with each fuse to indicate when it has blown.
 2. Mounting: Positively held in position with provision for easy removal and replacement from front without special tools.

3. Expulsion Fuses: Furnished in disconnect-type mountings and renewable with replacement fuse units. Gases emitted on interruption are controlled and silenced by chambers designed for that purpose.

2.4 METAL-CLAD, CIRCUIT-BREAKER SWITCHGEAR

A. Available Manufacturers:

1. ABB Control, Inc.
2. Eaton Corporation; Cutler-Hammer Products.
3. Square D; Schneider Electric.
4. <Insert manufacturer's name.>

B. Comply with IEEE C37.20.3.

C. Comply with IEEE C37.20.7. Provide arc-resistant switchgear, Type [1] [2] [1C] [2C] <Insert number>.

D. Nominal Interrupting-Capacity Class: [250] [350] [500] [750] [1000] MVA <Insert number>.

E. Ratings: Comply with IEEE C37.04.

1. Main-Bus Rating: [1200] [2000] [3000] <Insert number> A, continuous.

F. Circuit Breakers: Three-pole, single-throw, electrically operated, drawout-mounting units using three individual, [vacuum-sealed] [sulfur hexafluoride insulated and sealed] interrupter modules and including the following features:

1. Designed to operate at rated voltage to interrupt fault current within its rating within three 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 of Main Circuit Breaker: 2000 A.
 - b. Continuous Current Rating of Tie Circuit Breaker: 2000 A.
 - c. Continuous Current Rating of Feeder Circuit Breaker: 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: 24V dc for closing and tripping.
 - 2) Control Power: 120 V ac for closing and tripping.
 - c. Provide shunt trip capability independent of overcurrent trip.
- G. Test Accessories: Relay and meter test plugs.
- H. Low-DC-Voltage Alarm: Switchgear shall have a monitor for dc control power voltage with a remote contact output and Factory set alarm value at 80% of full-charge voltage.
- I. Grounding and Testing Device: Suitable for phasing out, testing, and grounding switchgear bus or feeder if device is installed in place of circuit breaker. Include the following:
- 1. Portable Grounding and Testing Device: Interchangeable with drawout-mounting, medium-voltage circuit breakers to provide interlocked electrical access to either bus or feeder; electrically operated.
 - 2. System control cabinet permanently mounted near switchgear.
 - 3. Portable Remote-Control Station: For grounding and testing device.
 - 4. Control-Cabinet Coupler Cable: Of adequate length to connect device inserted in any switchgear cubicle and control cabinet.
 - 5. Remote-Control Coupler Cable: Fifty (50) feet long to connect control cabinet and portable remote-control station.
 - 6. Permanent Control Power Wiring: From control cabinet to power source.
 - 7. Protective Cover: Fabricated of heavy-duty plastic and fitted to device.
 - 8. Approval of Grounding and Testing Device System: Obtain approval of final system design from utility company and agency designated by Owner to handle future maintenance of medium-voltage switchgear.
- J. Circuit-Breaker Test Cabinet: Separately mounted and containing push buttons for circuit-breaker closing and tripping, control relay, fuses, and secondary coupler with cable approximately one hundred eight (108) inches long. Include a set of secondary devices for operating circuit breaker if removed from switchgear and moved near test cabinet. Include provision for storage of test and maintenance accessories in cabinet.
- K. Remote-Tripping Device: Wall-mounting emergency control station to open circuit breakers; located in red cast-metal box with break-glass operation.

2.5 FABRICATION

- A. Indoor Enclosure: Steel.

-
- B. Outdoor Enclosure: Galvanized steel, weatherproof construction; integral structural-steel base frame with factory-applied asphaltic undercoating.
1. Each compartment shall have the following features:
 - a. Structural design and anchorage adequate to resist loads imposed by one hundred twenty five (125) mph wind.
 - b. Space heater operating at one-half or less of rated voltage, sized to prevent condensation.
 - c. Louvers equipped with insect and rodent screen and filter, and arranged to permit air circulation while excluding rodents and exterior dust.
 - d. Hinged front door with locking provisions.
 - e. Interior light with switch.
 - f. Weatherproof GFCI duplex receptacle.
 - g. Power for heaters, lights, and receptacles to be provided [by control power transformer] [as indicated].
 2. Weatherproof internal aisle construction shall have the following features:
 - a. Common internal aisle of sufficient width to permit protective-device withdrawal, disassembly, and servicing in aisle.
 - b. Aisle access doors at each end with exterior locking provisions and interior panic latches.
 - c. Aisle space heaters operating at one-half or less of rated voltage thermostatically controlled.
 - d. Vaporproof fluorescent aisle lights with low-temperature ballasts, controlled by wall switch at each entrance.
 - e. GFCI duplex receptacles, a minimum of two, located in aisle.
 - f. Aisle ventilation louvers equipped with insect and rodent screen and filter, and arranged to permit air circulation while excluding rodents and exterior dust.
- C. Finish: Manufacturer's standard gray finish over rust-inhibiting primer on phosphatizing-treated metal surfaces.
- D. Bus Transition Unit: Arranged to suit bus and adjacent units.
- E. Incoming-Line Unit: Arranged to suit incoming line.
- F. Outgoing Feeder Units: Arranged to suit distribution feeders.
- 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.

2.6 COMPONENTS

- A. Main Bus: Copper, silver plated at connection points; full length of switchgear.
- B. Ground Bus: Copper, silver plated or copper, tin plated; minimum size one quarter (1/4) inch by two (2) inches; full length of switchgear.
- C. Bus Insulation: Covered with flame-retardant insulation.
- D. 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.
- E. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems, listed and labeled by an NRTL, and with the following features:
 1. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
 2. Switch-selectable digital display with the following features:
 - a. Phase Currents, Each Phase: Plus or minus 1%.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1%.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1%.
 - d. Three-Phase Real Power: Plus or minus 2%.
 - e. Three-Phase Reactive Power: Plus or minus 2%.
 - f. Power Factor: Plus or minus 2%.
 - g. Frequency: Plus or minus 0.5%.
 - h. Integrated Demand, with Demand Interval Selectable from five minutes (5) to sixty (60) Minutes: Plus or minus 2%.
 - i. Accumulated energy, in megawatt hours, plus or minus 2%; stored values unaffected by power outages for up to seventy two (72) hours.
 3. Communications module suitable for remote monitoring of meter quantities and functions. Interface communication and metering requirements according to Division 26 Section "Electrical Power Monitoring and Control."
 4. Mounting: Display and control unit that is flush or semiflush mounted in instrument compartment door.

-
- F. Analog Instruments: Rectangular, four and one half (4-1/2) inches square, 1% accuracy, semiflush mounting, with antiparallax 250-degree scale and external zero adjustment, and complying with ANSI C39.1.
1. Voltmeters: Cover an expanded scale range of normal voltage plus 10%.
 2. Voltmeter Selector Switch: Rotary type with off position to provide readings of phase-to-phase [and phase-to-neutral] voltages.
 3. Ammeters: Cover an expanded scale range of bus rating plus 10 percent.
 4. Ammeter Selector Switch: Permits current reading in each phase and keeps current-transformer secondary circuits closed in off position.
 5. Locate meter and selector switch on circuit-breaker compartment door for indicated feeder circuits only.
- G. Relays: Comply with IEEE C37.90, integrated digital type; with test blocks and plugs.
- H. 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.
- I. Provision for Future Devices Equip compartments with rails, mounting brackets, supports, necessary appurtenances, and bus connections.
- J. Control Power Supply: DC battery system.
- K. Control Power Supply: Control power transformer supplies 120-V control circuits through secondary disconnect devices. Include the following features:
1. Dry-type transformers, in separate compartments for units larger than 3 kVA, including primary and secondary fuses.
 2. Two control power transformers in separate compartments with necessary interlocking relays; each transformer connected to line side of associated main circuit breaker.
 - a. Secondary windings connected through relay(s) to control bus to affect an automatic transfer scheme.
 - b. Secondary windings connected through an internal automatic transfer switch to switchgear control power bus.
 3. Control Power Fuses: Primary and secondary fuses provide current-limiting and overload protection.
- L. Control Wiring: Factory installed, complete with bundling, lacing, and protection; and complying with the following:
1. Flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2. Conductors sized according to NFPA 70 for duty required.

2.7 CONTROL BATTERY SYSTEM

- A. System Requirements: Battery shall have number of cells and ampere-hour capacity based on an initial specific gravity of 1.210 at 25°C with electrolyte at normal level and minimum ambient temperature of 13°C. Cycle battery before shipment to guarantee rated capacity on installation. Arrange battery to operate ungrounded.
- B. Battery: Lead-calcium type in sealed, clear plastic or glass containers, complete with electrolyte, fully charged and arranged for shipment with electrolyte in cells. Limit weight of each container to not more than 70 lb and cells per container to not more than 3. System batteries shall be suitable for service at an ambient temperature ranging from minus 18°C to 25°C. Limit variation of current output to 0.8 % for each degree below 25°C down to minus 8°C.
- C. Rack: Two-step rack with electrical connections between battery cells and between rows of cells; include two flexible connectors with bolted-type terminals for output leads
- D. Accessories:
 1. Thermometers with specific-gravity correction scales.
 2. Hydrometer syringes.
 3. Set of socket wrenches and other tools required for battery maintenance.
 4. Wall-mounting, nonmetallic storage rack fitted to store above items.
 5. Set of cell numerals.
- E. Charger: Static-type silicon rectifier equipped with automatic regulation and provision for manual and automatic adjustment of charging rate. Unit shall automatically maintain output voltage within 0.5 % from no load to rated charger output current, with ac input-voltage variation of plus or minus 10 percent and input-frequency variation of plus or minus 3 Hz. Other features of charger include the following:
 1. DC ammeter.
 2. DC Voltmeter: Maximum error of 5% at full-charge voltage; operates with toggle switch to select between battery and charger voltages.
 3. Ground Indication: Two appropriately labeled lights to indicate circuit ground, connected in series between negative and positive terminals, with midpoint junction connected to ground by normally open push-button contact.
 4. Capacity: Sufficient to supply steady load, float-charge battery between 2.20 and 2.25 V per cell and equalizing charge at 2.33 V per cell.
 5. Charging-Rate Switch: Manually operated switch provides for transferring to higher charging rate. Charger operates automatically after switch operation until manually reset.

6. AC power supply is 120 V, 60 Hz, subject to plus or minus 10 % variation in voltage and plus or minus 3-Hz variation in frequency. After loss of ac power supply for any interval, charger automatically resumes charging battery. Charger regulates rate of charge to prevent damage due to overload and to prevent fuses or circuit breakers from opening.
7. Protective Feature: Current-limiting device or circuit, which limits output current to rating of charger but does not disconnect charger from either battery or ac supply; to protect charger from damage due to overload, including short circuit on output terminals.
8. Electrical Filtering: Reduces charger's audible noise to less than 26 dB.

2.8 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 Architect.

2.9 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 and ship equipment to jobsite.

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.

2.10 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 four (4) inch, channel-iron sill embedded in [floor] [concrete base] <Select based type> and attach by bolting.
 1. Sills: Select to suit switchgear; level and grout flush into [floor] [concrete base] <Select base type>.
 2. Concrete Bases: Four (4) inches high, reinforced, with chamfered edges. Extend base no less than three (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."
- B. Diagram and Instructions:

1. Frame under clear acrylic plastic on front of switchgear.
 - a. Operating Instructions: Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.
 - b. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads.
2. Storage for Maintenance: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

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."
- E. Connect multifunction digital-metering monitor according to Division 26 Section "Electrical Power Monitoring."

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. Assist in field testing of equipment.
 3. Report results in writing. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

- C. Testing Agency: 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.
 - j. SCADA and automation equipment.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Infrared Scanning: After Substantial Completion, but not more than sixty (60) days after Final Acceptance, perform infrared scan of each switchgear. Remove front and rear panels so joints and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchgear eleven (11) months after date of Substantial Completion.
 - 2. Instrument: Use an infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies switchgear checked and that describes infrared-scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.6 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.

3.7 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 manufacturers stipulated service conditions.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchgear. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 261300