

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-enclosed, low-voltage power circuit-breaker switchgear rated 1000 V and less for use in AC systems.

1.3 SUBMITTALS

A. Product Data: For each type of switchgear, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each type of switchgear and related equipment.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:

- a. Tabulation of installed devices with features and ratings.
- b. Enclosure types and details.
- c. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
- d. Bus configuration with size and number of conductors in each bus run, including phase, neutral, and ground conductors of main and branch buses.
- e. Current rating of buses.
- f. Short-time and short-circuit current rating of switchgear assembly.
- g. Nameplate legends.
- h. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where pipe 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. Indicate field measurements.

B. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchgear and 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.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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 potential transformer fuses and control power fuses.
2. Indicating Lights: Two of each type installed.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain switchgear through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchgear in sections of lengths that can be moved past obstructions in delivery path.
- 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.

1.09 WARRANTY

- A. Comply with Division 1 requirements.
 - B. Special Warranty: Manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
1. Warranty Period: **two** years from date of Substantial completion

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Corp. Electrical Group.
 - 2. Siemens Industry Inc.
 - 3. Approved Equivalent

2.2 RATINGS

- A. Nominal System Voltage 600A. 208/120 V, 3PH. 4 wire, 60 Hz.
- B. Main-Bus Continuous: 600 A.
- C. Short-Time and Short-Circuit Current: Match rating of highest-rated circuit breaker in switchgear assembly.

2.3 FABRICATION

- A. Factory assembled and tested and complying with ANSI/IEEE C37.20.1 and UL 1558.
- B. Indoor Enclosure Material: Steel.
- C. Finish: ANSI/IEEE C37.20.1, manufacturer's standard gray finish over a rust-inhibiting primer on phosphatizing-treated metal surfaces.
- D. Section barriers between main and tie circuit-breaker compartments shall be extended to rear of section.
- E. Bus isolation barriers shall be arranged to isolate line bus from load bus at each main circuit breaker.
- F. Circuit-breaker compartments shall be equipped to house drawout-type circuit breakers and shall be fitted with hinged outer doors.
- G. Fabricate enclosure with removable, hinged, rear cover panels to allow access to rear interior of switchgear.
- H. Auxiliary Compartments: Match and align with basic switchgear assembly. Include the following:
 - 1. Bus transition sections.
 - 2. Incoming-line sections.
 - 3. Hinged front panels for access to metering, accessory, and blank compartments.
- I. Bus bars connect between vertical sections and between compartments. Cable connections are not permitted.
 - 1. Main Phase Bus: Uniform capacity the entire length of assembly.
 - 2. Neutral Bus: 100 percent of phase-bus ampacity, except as indicated. Equip bus with pressure-connector terminations for outgoing circuit neutral conductors. Include braces for neutral-bus extensions for busway feeders.
 - 3. Vertical Section Bus Size: Comply with IEEE C37.20.1, including allowance for spare circuit breakers and spaces for future circuit breakers.
 - 4. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent minimum conductivity, with copper feeder circuit-breaker line connections.
 - 5. Use copper for connecting circuit-breaker line to copper bus.

6. Contact Surfaces of Buses: Silver plated.
7. Feeder Circuit-Breaker Load Terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.
8. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector for feeder and branch-circuit ground conductors, minimum size 1/4 by 2 inches (6 by 50 mm).
9. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents.
10. Service Entrance shall comply with UL Service Entrance requirements: service entrance label, incoming line isolation barriers, neutral connection to switchgear ground for solidly grounded wye systems.
11. Neutral bus equipped with pressure-connector terminations for outgoing circuit neutral conductors. Neutral-bus extensions for busway feeders are braced.
12. Neutral Disconnect Link: Bolted, un-insulated, 1/4-by-2-inch (6-by-50-mm) copper bus, arranged to connect neutral bus to ground bus.
13. Provide for future extensions from either end of main phase, neutral, and ground bus by means of predrilled bolt-holes and connecting links.
14. Bus-Bar Insulation: Individual bus bars wrapped with factory-applied, flame-retardant tape or spray-applied, flame-retardant insulation.
 - a. Sprayed Insulation Thickness: 3 mils (0.08 mm), minimum.
 - b. Bolted Bus Joints: Insulate with secure joint covers that can easily be removed and reinstalled.

2.4 COMPONENTS

- A. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.
- B. 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: Ratios as indicated; burden and accuracy class suitable for connected relays, meters, and instruments.
- C. Comply with Section 26 2713 "Electricity Metering" requirements.
- D. Multifunction Digital-Metering Monitor: UL-listed or -recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Comply with Section 26 2713 "Electricity Metering" requirements.
 2. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
 3. Selectable digital display of the following:
 - a. Accuracy: Power meter shall meet ANSI C12.20 for Class 2 and IEC 62053-22 accuracy requirements.
 - b. Phase Currents, Each Phase.
 - c. Phase-to-Phase Voltages, Three-Phase.
 - d. Phase-to-Neutral Voltages, Three-Phase.
 - e. Three-Phase Real Power.
 - f. Three-Phase Reactive Power.
 - g. Power Factor.
 - h. Frequency.
 - i. Power demand shall be simultaneously calculated using five different averaging methods: Fixed Window (Block) Average, Sliding Window (Rolling Block) Average, Thermal Average, Predicted Average, and Cumulative Demand. Values for all averaging intervals must be available simultaneously.
 - j. Accumulated Watt-hr, VA-hr, and VAR-hr; Watt-hr received; Watt-hr delivered.
 4. Metering Compartment: Provide 6 port Ethernet switch, graphic display module, meter, gateway, RJ45 to RJ45 receptacle, 120 VAC to 12 VDC power supply. Display and control unit flush or semi-flush mounted in instrument compartment door.
- F. Relays: Comply with IEEE C37.90, types and settings as indicated; with test blocks and plugs.
- G. Surge Arresters: UL listed surge protective device.

H. Provision for Future Devices: Equip compartments with rails, mounting brackets, supports, necessary appurtenances, and bus connections.

I. Control Power Supply: Control power transformer supplying 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. Control Power Fuses: Primary and secondary fuses with current-limiting and overload protection.

J. 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.

2.5 CIRCUIT BREAKERS

A. Description: Comply with IEEE C37.13 AND UL 1066.

B. Ratings: As indicated, fully rated, for continuous, interrupting, and short-time current ratings for each circuit breaker; voltage and frequency ratings same as switchgear.

C. Main circuit breakers shall have a minimum 600 A frame.

D. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:

1. Normal Closing Speed: Independent of both control and operator.
2. Slow Closing Speed: Optional with operator for inspection and adjustment.
3. Operation counter.

E. Trip Devices: Solid-state, overcurrent trip-device system consisting of one or two current transformers or sensors per phase, a release mechanism, and the following features:

1. Eaton Digi-Trip 1150 plus or equivalent
2. Functions: Long-time-delay, short-time-delay, and instantaneous-trip functions, independent of each other in both action and adjustment.
3. Minimum sensor size shall be 600 A which can be set at 50 percent of breaker rating.
4. Temperature Compensation: Ensures accuracy and calibration stability from minus 5 to plus 40 deg C.
5. Field-adjustable, time-current characteristics.
6. Current Adjustability: Dial settings and rating plugs on trip units or sensors on circuit breakers, or a combination of these methods.
7. Three bands, minimum, for long-time- and short-time-delay functions; marked "minimum," "intermediate," and "maximum."
8. Pickup Points: Five minimum, for long-time- and short-time-trip functions. Equip shorttime- trip function for switchable 1zt operation.
9. Pickup Points: Five minimum, for instantaneous-trip functions.
10. Ground-fault protection with at least three short-time-delay settings and three trip-timedelay bands; adjustable current pickup. Arrange to provide protection for the following:
 - a. Three-wire circuit or system.
 - b. Four-wire circuit or system.
 - c. Four-wire, double-ended substation.
11. Trip Indication: Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.
12. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking phase and ground-fault protection function with the downstream circuit breakers so that the breaker closest to the fault will clear the fault without disruption of service to other parts of the distribution system.
13. Maintenance mode switched trip units: The trip unit shall utilize Arc Flash Reduction Maintenance System to reduce the instantaneous pickup value when activated. The ARMS shall provide a clearing time of 0.04 seconds with a minimum of settings from 2.5X to 10X of the sensor value. The ARMS shall be enabled by a switch on the trip unit with blue indicator LED. A remote communication link shall also be provided for enable/disable and confirmation.

F. Phase rotation indicators: Bright LED lamps indicate phase live or open, correct phase sequence, with fuse protected inputs. Provide on each main.

G. Auxiliary Contacts: For interlocking or remote indication of circuit-breaker position, with spare auxiliary switches and other auxiliary switches required for normal circuit-breaker operation, quantity as indicated. Each consists of two-type "a" and two-type "b" stages (contacts) wired through secondary disconnect devices to a terminal block in stationary housing.

H. Drawout Features: Circuit-breaker mounting assembly equipped with a racking mechanism to position circuit breaker and hold it rigidly in connected, test, and disconnected positions. Include the following features:

1. Interlocks: Prevent movement of circuit breaker to or from connected position when it is closed, and prevent closure of circuit breaker unless it is in connected, test, or disconnected position.
2. Circuit-Breaker Positioning: An open circuit breaker may be racked to or from connected, test, and disconnected positions only with the associated compartment door closed unless live parts are covered by a full dead-front shield. An open circuit breaker may be manually withdrawn to a position for removal from the structure with the door open. Status for connection devices for different positions includes the following:
 - a. Test Position: Primary disconnect devices disengaged, and secondary disconnect devices and ground contact engaged.
 - b. Disconnected Position: Primary and secondary devices and ground contact disengaged.

I. Padlocking Provisions: For installing at least three padlocks on each circuit breaker to secure its enclosure and prevent movement of drawout mechanism. Provisions shall be included for padlocking the breaker in the open or closed position.

J. Operating Handle: One for each circuit breaker capable of manual operation.

K. Electric Close Button: One for each electrically operated circuit breaker.

L. Mechanical Interlocking of Circuit Breakers: Uses a mechanical tripping lever or equivalent design and electrical interlocks.

M. Indicating Lights: To indicate circuit breaker is open or closed, for main and bus tie circuit breakers interlocked either with each other or with external devices.

N. Lugs: Mechanical style, rated for Copper conductors only, suitable for number, size, and trip ratings.

O. Grounding Ball Studs: provide on incoming lug pad and outgoing lug pad.

P. Provide shorting blocks for maintenance.

2.6 SPACE FOR FUTURE DEVICES

A. Where indicated on the Drawings, "space" shall mean fully provisioned space ready for inserting a circuit breaker at a future date without any future modifications. Provide current transformers sized according to the breaker frame size. A blank door shall close off the front of the compartment.

2.7 ACCESSORIES

A. Accessory Set: Furnish tools and miscellaneous items required for circuit-breaker and switchgear test, inspection, maintenance, and operation.

1. Racking handle to manually move circuit breaker between connected and disconnected positions.
2. Portable test set for testing all functions of circuit-breaker, solid-state trip devices without removal from switchgear.
3. Relay and meter test plugs suitable for testing switchgear meters and switchgear class relays.

B. Circuit-Breaker Removal Apparatus: Overhead-circuit-breaker lifting device, track mounted at top front of switchgear and complete with hoist and lifting yokes matching each size of draw out circuit breaker installed.

C. Storage for Manual: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces where switchgear will be installed for compliance with installation tolerances, required clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instruction

- B. Anchor switchgear assembly to concrete base and attach by bolting.
 - 1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 3 inches (75 mm) in all directions beyond the maximum dimensions of switchgear unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from switchgear units and components.
- D. Provide wall mounted cabinet with lockable hinged door, to store all accessories, test equipment, small spares, operating and maintenance manuals, and maintenance ledger in same room as equipment.

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. Arc Flash Labels: provide as specified in Division 26 Section "Identification for Electrical Systems."
- C. Diagram and Instructions:
 - 1. Frame and mount under clear acrylic plastic on the front of switchgear or on nearest adjacent wall.
 - 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.

3.4 CONNECTIONS

- A. Ground equipment according to Section 26 05 26
- B. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.
- C. Verify tightness and torque all accessible bolted electrical connections to manufacturer's specified values using a calibrated torque wrench. Provide a list of all torqued connections and values.

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 installation, including wiring, components, connections, and equipment. Test and adjust components and equipment.
 - 2. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 26 Sections.
 - 3. Complete installation and startup checks according to manufacturer's written instructions.
 - 4. Assist in field testing of equipment including pretesting and adjusting of equipment and components.
 - 5. Report results in writing.

3.6 ADJUSTING

Set field-adjustable, protective-relay trip characteristics as specified in the "Overcurrent Protective Device Coordination Study." Provide list of "as left" settings and submit to Electric Shop and include in O & M manuals.

3.7 CLEANING

On completion of installation, inspect interior and exterior of switchgear. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION