

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes service and distribution switchboards rated 600 V and less.

1.2 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RMS: Root mean square.
- D. SPDT: Single pole, double throw.

1.3 SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of switchboards and overcurrent protective devices.
 - d. Descriptive documentation of optional barriers specified for electrical insulation and isolation.
 - e. Mimic-bus diagram.
 - f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. For existing installations verify space available with equipment sizes and code required working clearances prior to submittal of shop drawings.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples: Representative portion of mimic bus with specified finish, for color selection.
- D. Manufacturer Seismic Qualification Certification: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 26 05 29 Hangers and Supports 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."

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.
 - E. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 26 05 00 Common Work Results for Electrical, include the following:
 1. Routine maintenance requirements for switchboards and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 3. Time-current curves, including selectable ranges for each type of overcurrent protective device.
- 1.4 COORDINATION STUDY
- A. Refer to Section 26 05 73, Power System Studies.
- 1.5 QUALITY ASSURANCE
- A. Source Limitations: Obtain switchboards through one source from a single manufacturer.
 - B. Product Selection for Restricted Space: Maximum 92 inches (not including base channels). Length and depth: Not exceeding dimensions as scaled or noted in contract documents. Equipment exceeding dimensions not allowed. Base bid on equipment complying with contract documents.
 - C. Comply with NEMA PB 2, "Deadfront Distribution Switchboards."
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver in sections or lengths that can be moved past obstructions in delivery path.
 - B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.
 - C. Handle switchboards according to NEMA PB 2.1 and NECA 400.
- 1.7 PROJECT CONDITIONS
- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
 - B. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 2. Altitude: Not exceeding 6600 feet (2000 m).

1.8 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels. Coordinate work so piping, ducts, etc. are routed around dedicated spaces above and in front of switchboards per code.
- B. Coordinate size and location of concrete bases per section 26 05 00 Common Work Results for Electrical.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Eaton Corporation; Cutler-Hammer Products
- B. General Electric Company
- C. Siemens Energy & Automation, Inc.
- D. Square D; Schneider Electric
- E. Industrial Electric Manufacturing, (IEM).

2.2 SWITCHBOARD STRUCTURE

- A. Front-Connected, Front-Accessible Switchboard: Fixed, individually mounted main device, panel-mounted branches, and sections rear aligned.
- B. Enclosure: Steel, NEMA 250, Type 1
- C. Enclosure Finish
 - 1. Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- D. Barriers: Provide barriers between adjacent switchboard sections.
- E. Space for future fused switches or breakers noted including complete bussing and required hardware for mounting devices.
- F. Cleats for securing conductors. Miscellaneous appurtenances as required for complete installation.
- G. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- H. Removable, Hinged Doors and Compartment Covers: Secured by captive thumb screws, for access to rear interior of switchboard.

- I. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- J. Pull Box on Top of Switchboard:
 - 1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
 - 2. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
 - 3. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
 - 4. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

2.3 SWITCHBOARD BUSBARS

- A. Three phase, four wire, unless otherwise indicated. Brace switchboard components for symmetrical fault current shown plus asymmetrical offset (50,000 amp symmetrical bracing minimum).
- B. Bus: Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity with feeder circuit-breaker line connections.
- C. Circuit Breaker Connections
 - 1. Use copper for feeder circuit-breaker line connections.
- D. Contact Surfaces: Silver plated
- E. Load Terminals: Insulated, rigidly braced, silver-plated, copper runback bus extensions equipped with pressure connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full ampere rating of circuit-breaker position.
- F. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extension from one end.
- G. Vertical Section Bus: Match main phase bus. For drawout or individually mounted circuit breakers, match the ampacity of the sum of the circuit breaker frame sizes.
- H. Neutral Buses: 100 percent of the ampacity of phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
- I. Ground Bus: Full length ground bus bonded to frame conforming with U.L. 891 for minimum size except larger as required by code for grounding neutral conductor. Hard drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
- J. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.4 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip-unit circuit breakers shall have RMS sensing, field-replaceable rating plug, and the following discrete (field-adjustable) settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time delay adjustments.
 - d. Ground-fault pickup level, time delay, and I₂t response.
 4. Electronic trip-units shall provide local trip indication, i.e. overload, short circuit or ground fault.
 5. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 6. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 2. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 3. Communication Capability: Din-rail-mounted communication module with functions and features compatible with power monitoring and control system.
 4. Shunt Trip: 120 VAC trip coil energized from separate circuit, set to trip at **75** percent of rated voltage.
 5. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 6. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 7. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
- C. Enclosed, Insulated-Case Circuit Breaker: Fully rated, encased-power circuit breaker with interrupting capacity rating to meet available fault current.
1. Fixed circuit-breaker mounting.
 2. Two-step, stored-energy closing.
 3. Microprocessor-based trip units with interchangeable rating plug, LED trip indicators, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments with I₂t response.
 - d. Ground-fault pickup level, time delay, and I₂t response.

4. Remote trip indication and control.
5. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified.
6. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
7. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
8. Control Voltage: 125-V, ac.

2.5 INSTRUMENTATION

- A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:
 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 shall be as indicated with revenue metering accuracy class and burden suitable for connected relays, meters, and instruments.
 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kV.
- B. Multifunction Digital-Metering: Refer to Section 26 27 00 Electrical Power Monitoring.
 1. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.6 CONTROL POWER

- A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Furnish portable test set to test functions of solid-state trip devices without removal from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

2.8 IDENTIFICATION

- A. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

- B. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.

2.9 NAMEPLATES

- A. Provide permanently attached engraved nameplates per Section 26 05 53 - Identification For Electrical Systems for each switchboard, every instrument, and protective device and disconnect device. For each switchboard include name (3/8" letters), voltage, phase and U.L. short circuit rating (1/4" letters). For each protective device and disconnect include load (1/4" letters) and area served (1/8" letters) and fuse size and type when fused (1/8" letters).
- B. Nameplate color shall be: Normal System - white on black; Emergency System - white on red.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.2 EXAMINATION

- A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1 and NECA 40.
- B. Install and anchor switchboards level on concrete bases as specified in Section 26 05 00- Common Work Results for Electrical. Bolt to floor using 1/2" diameter drilled in concrete anchors with 4 1/2" minimum inbedment in structural floor slab.
- C. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- D. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges in accordance with coordination study.

3.4 WIRING

- A. Conform with applicable specification sections. Conductors and terminations shall conform with Section 26 05 19 - Copper Conductors and Cables. Secure all conductors to switchboard structure.

3.5 GROUNDING

- A. Provide per Section 26 05 26 - Grounding.

3.6 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 26 05 53-Identification for Electrical Systems.
- B. Switchboard Nameplates: Label each switchboard component with engraved laminated-plastic nameplate mounted with corrosion-resistant screws.

END OF SECTION