

SECTION 26 24 13
DISTRIBUTION SWITCHBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of the low-voltage circuit-breaker distribution switchboards, indicated as switchboard(s) in this section.

1.2 RELATED WORK

- A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.
- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint for nonstructural components.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- D. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible fault currents.
- F. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit.
- G. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.
- H. Section 26 11 16, SECONDARY UNIT SUBSTATIONS: Switchboards as part of secondary unit substations.
- I. Section 26 25 11, BUSWAYS: Feeder busway and fittings.
- J. Section 26 43 13, SURGE PROTECTIVE DEVICES: Surge protective devices for switchboards.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

- A. Switchboards shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects. Tests shall be conducted as per NEMA PB 2. Factory tests shall be certified.
- B. The following additional tests shall be performed:

1. Verify that circuit breaker sizes and types correspond to drawings, and the Overcurrent Protective Device Coordination Study.
 2. Verify tightness of bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 3. Exercise all active components.
 4. Perform an insulation-resistance test, phase to ground, on each bus section, with phases not under test grounded, in accordance with manufacturer's published data.
 5. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 V DC for 300-volt rated cable and 1000 V DC for 600-volt rated cable, or as required if solid-state components or control devices cannot tolerate the applied voltage.
 6. If applicable, verify correct function of control transfer relays located in the switchboard with multiple control power sources.
 7. Perform phasing checks on double-ended or dual-source switchboards to insure correct bus phasing from each source.
- C. Furnish four (4) copies of certified manufacturer's factory test reports prior to shipment of the switchboards to ensure that the switchboards have been successfully tested as specified.

1.5 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
 - a. Switchboard shop drawings shall be submitted simultaneously with or after the Overcurrent Protective Device Coordination Study.
 - b. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - c. Prior to fabrication of switchboards, submit the following data for approval:
 - 1) Complete electrical ratings.
 - 2) Circuit breaker sizes.
 - 3) Interrupting ratings.
 - 4) Safety features.
 - 5) Accessories and nameplate data.
 - 6) Switchboard one line diagram, showing ampere rating, number of bars per phase and neutral in each bus run (horizontal and

vertical), bus spacing, equipment ground bus, and bus material.

- 7) Elementary and interconnection wiring diagrams.
- 8) Technical data for each component.
- 9) Dimensioned exterior views of the switchboard.
- 10) Dimensioned section views of the switchboard.
- 11) Floor plan of the switchboard.
- 12) Foundation plan for the switchboard.
- 13) Provisions and required locations for external conduit and wiring entrances.
- 14) Approximate design weights.

- d. Certification from the manufacturer that representative switchboards have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:

- a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - 1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the switchboard.
 - 2) Include information for testing, repair, trouble shooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
 - 3) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.

- a. Certification by the manufacturer that the switchboards conform to the requirements of the drawings and specifications.

- b. Certification by the Contractor that the switchboards have been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. Institute of Engineering and Electronic Engineers (IEEE):
 - C37.13-08.....Low Voltage AC Power Circuit Breakers Used in Enclosures
 - C57.13-08.....Instrument Transformers
 - C62.41.1-03.....Surge Environment in Low-voltage (1000V and less) AC Power Circuits
 - C62.45-92.....Surge Testing for Equipment connected to Low-Voltage AC Power Circuits
- C. International Code Council (ICC):
 - IBC-12.....International Building Code
- D. National Electrical Manufacturer's Association (NEMA):
 - PB-2-06.....Deadfront Distribution Switchboards
 - PB-2.1-07.....Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less
- E. National Fire Protection Association (NFPA):
 - 70-14.....National Electrical Code (NEC)
- F. Underwriters Laboratories, Inc. (UL):
 - 67-09.....Panelboards
 - 489-09.....Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
 - 891-05.....Switchboards

PART 2 - PRODUCTS

2.1 GENERAL

- A. Shall be in accordance with ANSI, IEEE, NEMA, NFPA, UL, as shown on the drawings, and have the following features:
 - 1. Switchboard shall be a complete, grounded, continuous-duty, integral assembly, dead-front, dead-rear, self-supporting, indoor type switchboard assembly. Incorporate devices shown on the drawings and

- all related components required to fulfill operational and functional requirements.
2. Ratings shall not be less than shown on the drawings. Short circuit ratings shall not be less than the available fault current shown in the Overcurrent Protective Device Coordination Study.
 3. Switchboard shall conform to the arrangements and details shown on the drawings.
 4. Switchboards shall be assembled, connected, and wired at the factory so that only external circuit connections are required at the construction site. Split the structure only as required for shipping and installation. Packaging shall provide adequate protection against rough handling during shipment.
 5. All non-current-carrying parts shall be grounded per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS for additional requirements.
 6. Series rated switchboards are not allowed.

2.2 BASIC ARRANGEMENT

- A. Type 2: Switchboard shall be rear accessible with the following features:
 1. Device mounting:
 - a. Main breaker: Individually mounted and compartmented.
 - b. Feeder breakers: Individually mounted and compartmented.
 2. Section alignment: As shown on drawings.
 3. Accessibility:
 - a. Main section line and load terminals: Rear.
 - b. Distribution section line and load terminals: Rear.
 - c. Bus connections: Rear.
 4. Bolted line and load connections.
 5. Full height wiring gutter covers for access to wiring terminals.

2.3 HOUSING

- A. Shall have the following features:
 1. Frames and enclosures:
 - a. The assembly shall be braced with reinforcing gussets using bolted connections or jig welds to assure rectangular rigidity.
 - b. The enclosure shall be steel, leveled, and not less than the gauge required by applicable publications.

- c. Die-pierce the holes for connecting adjacent structures to insure proper alignment, and to allow for future additions.
 - d. All bolts, nuts, and washers shall be zinc-plated cadmium-plated steel.
- B. Finish:
- 1. All metal surfaces shall be thoroughly cleaned, phosphatized and factory primed prior to applying baked enamel or lacquer finish.
 - 2. Provide a light gray finish for indoor switchboard.
- C. Viewing Ports: Provide infrared inspection window ports so that cable connections may be infrared inspected without opening doors or exposing live parts. Ports may be field installed using Basis of design Product FLIR IR Window sized for each location of incoming and distribution feeder connections.

2.4 BUSES

- A. Bus Bars and Interconnections:
- 1. Provide copper phase and neutral buses, fully rated for the amperage as shown on the drawings for the entire length of the switchboard. Bus laminations shall have a minimum of 6 mm (1/4 inch) spacing.
 - 2. Mount the buses on appropriately spaced insulators and brace to withstand the available short circuit currents.
 - 3. The bus and bus compartment shall be designed so that the acceptable NEMA standard temperature rises are not exceeded.
 - 4. Install a copper ground bus the full length of the switchboard assembly.
 - 5. Main Bonding Jumper: An un-insulated copper bus, size as shown on drawings, shall interconnect the neutral and ground buses, only when the switchboard is used to establish the system common ground point.
 - 6. All bolts, nuts, and washers shall be zinc-plated or cadmium-plated steel. Bolts shall be torqued to the values recommended by the manufacturer.
 - 7. Make provisions for future bus extensions by means of bolt holes or other approved method.

2.5 MAIN CIRCUIT BREAKERS

- A. Type I or Type II Switchboards: Provide molded case main circuit breakers as shown on the drawings. Circuit breakers shall be the solid state adjustable trip type.

1. Trip units shall have field adjustable tripping characteristics with long time, short time and instantaneous settings.
 - a. zone selective interlocking
 - b. communication with power management control system.
 - c. rating plugs shall be field adjustable.
 2. Breakers with same frame size shall be interchangeable with each other.
 3. Breakers shall be fully rated for interrupt current.
- B. Type II Switchboards: Provide main power circuit breakers as shown on the drawings. Circuit breakers shall be the solid state adjustable trip type.
1. General: Circuit breakers shall be dead front, stored energy type with solid state trip devices.
 - a. Trip units shall have field adjustable tripping characteristics with long time, short time and instantaneous settings.
 - b. zone selective interlocking
 - c. communication with power management control system.
 - d. rating plugs shall be field adjustable.
 2. Rating: Circuit breakers shall be 3 pole, 600 V AC and below, 60 cycle with frame size, trip rating and functions, and system voltage as shown on drawings. Breakers shall have 30 cycle short time current ratings.
 3. Position Indicator: Provide a mechanical indicator visible from the front of the unit to indicate whether the breaker is open or closed.
 4. Trip Button: Equip each breaker with a mechanical trip button accessible from the front of the door.
 5. Padlocking: Provisions shall be included for padlocking the breaker in the open position.
 6. Operation: Unless otherwise indicated herein or on the drawings, breakers shall be manually operated.

2.6 FEEDER CIRCUIT BREAKERS

- A. Provide molded case circuit breakers with solid state adjustable trip units.
- B. Adjustable Trip Molded Case Circuit Breakers:
 1. Provide molded case, solid state adjustable trip type circuit breakers.

- a. Trip units shall have field adjustable tripping characteristics with long time, short time and instantaneous settings.
 - b. zone selective interlocking
 - c. communication with power management control system.
 - d. rating plugs shall be field adjustable.
2. Breakers with same frame size shall be interchangeable with each other.
 2. Rating: Circuit breakers shall be 3 pole, 600 V AC and below, 60 cycle with frame size, trip rating and functions, and system voltage as shown on drawings. Breakers shall have 30 cycle short time current ratings.
 3. Position Indicator: Provide a mechanical indicator visible from the front of the unit to indicate whether the breaker is open or closed.
 4. Trip Button: Equip each breaker with a mechanical trip button accessible from the front of the door.
 5. Padlocking: Provisions shall be included for padlocking the breaker in the open position.
 6. Operation: Unless otherwise indicated herein or on the drawings, breakers shall be manually operated.

2.7 DIGITAL TRIP UNITS

- A. Each main and feeder circuit breaker shall be equipped with a digital electronic trip unit. The trip unit shall provide protection from overloads, and short circuits. The protective trip unit shall consist of a solid state, microprocessor based programmer; tripping means; current sensors; power supply and other devices as required for proper operation.
- B. The protective trip unit shall consist of a solid state, microprocessor based programmer; tripping means; current sensors; power supply and other devices as required for proper operation.
- C. Long time and short time protective functions shall have true RMS sensing technology for harmonic rich currents including up to the 19th harmonic.
- D. High contrast liquid crystal display (LCD) unit shall display settings, trip targets, and the specified metering displays.
- E. A multi-button keypad shall provide local setup and readout of all trip settings on the LCD.

- F. UL Listed interchangeable rating plug. It shall not be necessary to remove the trip unit to change the rating plug. Rating plugs shall be available in sizes from 40% to 100% of the breaker sensor rating
- G. The trip unit shall have an integral test jack for testing via a portable test set and connection to a battery source.
- H. Noise immunity shall meet the requirements of IEEE C37.90.
- I. The trip unit shall display trip targets for long time, short time, and ground fault, if included.
- J. Provide visual illuminated indication of the trip unit (normal, pickup, trip, error).
- K. The trip unit shall be provided with a ten event trip history log. Each trip event shall be recorded with type, phase and magnitude of fault that caused the trip
- L. As a minimum, the trip unit shall have the following protective functions:
 - 1. Current setting or long time pickup, adjustable from 50% to 100% of the rating plug value.
 - 2. Adjustable long time delay with typical inverse time characteristics (minimum of 10 bands). In addition, a set of straight line fuse shaped long time delay bands shall be provided to facilitate selectivity with downstream fuses (minimum 7 bands).
 - 3. Instantaneous pickup, adjustable from 2.0 to 10 times the rating plug in 0.5 increments
 - 4. Short time pickup and delay. Short time pickup shall be adjustable from 1.5 to 9 times the long time pickup setting in 0.5 increments with an OFF option. Provide minimum of 12 short time delay bands with three selectable I²t bands.
- M. Zone Selective Interlocking for Short Time and Instantaneous protection.
- N. The trip unit shall display rms current, each phase, on the LCD.

2.8 SURGE PROTECTIVE DEVICES

- A. Provide Surge protective Device in each emergency power (ESS) switchboard and where shown on drawings. Refer to Section 26 43 13, SURGE PROTECTIVE DEVICES.

2.9 OTHER EQUIPMENT

- A. Furnish tools and accessories required for circuit breaker and switchboard test, inspection, maintenance, and proper operation.

2.10 CONTROL WIRING

- A. Switchboard control wires shall not be less than No. 14 AWG copper 600 volt rated. Install wiring complete at the factory, adequately bundled and protected. Provide separate control circuit fuses in each breaker compartment and locate for ease of access and maintenance.

2.11 NAMEPLATES AND MIMIC BUS

- A. Nameplates: For Normal Power system, provide laminated black phenolic resin with white core with 12 mm (1/2 inch) engraved lettered nameplates next to each circuit breaker. For Essential Electrical System, provide laminated red phenolic resin with white core with 12 mm (1/2 inch) engraved lettered nameplates next to each circuit breaker. Nameplates shall indicate equipment served, spaces, or spares in accordance with one line diagram shown on drawings. Nameplates shall be mounted with plated screws on front of breakers or on equipment enclosure next to breakers. Mounting nameplates only with adhesive is not acceptable.
- B. Mimic Bus: Provide an approved mimic bus on front of each switchboard assembly. Color shall be black for the Normal Power system and red for the Essential Electrical System, either factory-painted plastic or metal strips. Plastic tape shall not be used. Use symbols similar to one line diagram shown on drawings. Plastic or metal strips shall be mounted with plated screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install switchboards in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.
- B. Anchor switchboards with rustproof bolts, nuts, and washers not less than 13 mm (1/2 inch) diameter, in accordance with manufacturer's instructions, and as shown on drawings.
- C. See specification section 13 05 51 Seismic Restraint Requirements for Non-Structural Components: switchboards shall be adequately anchored and braced to withstand the seismic forces at the location where installed.
- D. Interior Location. Mount switchboard on concrete slab. Unless otherwise indicated, the slab shall be at least 100 mm (4 inches) thick. The top of the concrete slab shall be approximately 100 mm (4 inches) above finished floor. Edges above floor shall have 12.5 mm (1/2

inch) chamfer. The slab shall be of adequate size to project at least 200 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

- E. Install infrared inspection ports at locations allowed for penetration in enclosures and to permit viewing access to lug. Tie cables so as not to obstruct view of lugs.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:

- a. Compare equipment nameplate data with specifications and approved shop drawings.
- b. Inspect physical, electrical, and mechanical condition.
- c. Verify appropriate anchorage, required area clearances, and correct alignment.
- d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
- e. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
- f. Vacuum-clean switchboard enclosure interior. Clean switchboard enclosure exterior.
- g. Inspect insulators for evidence of physical damage or contaminated surfaces.
- h. Verify correct shutter installation and operation.
- i. Exercise all active components.
- j. Verify the correct operation of all sensing devices, alarms, and indicating devices.
- k. Verify that vents are clear.

2. Electrical tests:

- a. Perform insulation-resistance tests on each bus section.
- b. Perform insulation-resistance test on control wiring; do not perform this test on wiring connected to solid-state components.

- c. Perform phasing check on double-ended switchboards to ensure correct bus phasing from each source.

3.3 FOLLOW-UP VERIFICATION

- A. Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the switchboard is in good operating condition and properly performing the intended function.

3.4 WARNING SIGN

- A. Mount on each entrance door of the switchboard room, approximately 1500 mm (5 feet) above grade or floor, a clearly lettered warning sign for warning personnel. The sign shall be attached with rustproof metal screws.

3.5 ONE LINE DIAGRAM AND SEQUENCE OF OPERATION

- A. At final inspection, an as-built one line diagram shall be laminated or mounted under acrylic glass, and installed in a frame mounted in the switchboard room or in the outdoor switchboard enclosure.
- B. Furnish a written sequence of operation for the switchboard and connected line side/load side electrical distribution equipment. The sequence of operation shall be laminated or mounted under acrylic glass, and installed in a frame mounted in the switchboard room or in the outdoor switchboard enclosure.
- C. Deliver an additional four copies of the as-built one line diagram and sequence of operation to the COR.

3.6 AS-LEFT TRIP UNIT SETTINGS

- A. The trip unit settings shall be set in the field by an authorized representative of the switchboard manufacturer per the approved Electrical System Protective Device Study in accordance with Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY. Verify settings with primary injection testing.
- B. Post a durable copy of the "as-left" trip unit settings in a convenient location in the switchboard room. Deliver four additional copies of the settings to the COR. Furnish this information prior to the activation of the switchboard.

3.7 INSTRUCTION

- A. Furnish the services of a factory-trained technician for one, 4-hour training period for instructing personnel in the maintenance and operation of the switchboards, on the dates requested by the COR.

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