

SECTION 26 24 13
DISTRIBUTION SWITCHBOARDS

SPEC WRITER NOTES: Use this section only for NCA projects. Delete between // -- // if not applicable to project. Also, delete any other item or paragraph not applicable to the section and renumber the paragraphs.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of the distribution switchboards.

1.2 RELATED WORK

- A. Section 25 10 10, ADVANCED UTILITY METERING SYSTEM: For electric metering devices integral to the distribution switchboards.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that apply to more than one section of Division 26.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- D. 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.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and outlet boxes.

1.3 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

- A. Factory Tests shall be required.
- B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
- C. The following additional tests shall be performed:
1. Verify that circuit breaker sizes and types correspond to drawings and 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 a dielectric withstand voltage test on each bus section, each phase-to-ground 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 volts dc for 300-volt rated cable and 1000 volts 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.

1.5 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 1. Shop Drawings:
 - a. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, temperature rise, wiring and connection diagrams, plan, front, side, and rear elevations, sectional views, bus work, circuit breaker frame sizes, trip and short-circuit rating, long-time, short-time, instantaneous and ground fault settings, coordinated breaker and fuse curves, accessories, and device nameplate data.
 - c. Show the size, ampere-rating, number of bars per phase and neutral in each bus run (horizontal and vertical), bus spacing, equipment ground bus, and bus material.
 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) Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.

- 2) Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnection between the items of equipment.
 - 3) Provide a clear and concise description of operation, which gives, in detail, the information required to properly operate the equipment.
 - 4) Approvals will be based on complete submissions of manuals together with shop drawings.
- b. Two weeks prior to final inspection, deliver four copies of the final updated maintenance and operating manuals to the Resident Engineer/COR.
- 1) The manuals shall be updated to include any information necessitated by shop drawing approval.
 - 2) Complete "As Installed" wiring and schematic diagrams shall be included which show all items of equipment and their interconnecting wiring.
 - 3) Show all terminal identification.
 - 4) Include information for testing, repair, trouble shooting, assembly, disassembly, and recommended maintenance intervals.
 - 5) Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
 - 6) Furnish manuals in loose-leaf binder or manufacturer's standard binder.
3. Certifications:
- a. Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer/COR:
 - 1) Certification by the Contractor that the assemblies have been properly installed, adjusted and tested, including circuit breakers settings.
 - 2) Certified copies of all of the factory design and production tests, field test data sheets and reports for the assemblies.

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):
 - C57.13-16.....Instrument Transformers
 - C62.41-91.....Surge Voltage in Low Voltage AC Power Circuits
 - C62.45-02.....Surge Testing for Equipment connected to Low-
Voltage AC Power Circuits
- C. National Electrical Manufacturer's Association (NEMA):
 - PB 2-11.....Dead-Front Distribution Switchboards.
 - PB 2.1-13.....Instructions for Proper Handling, Installation,
Operation, and Maintenance of Switchboards
- D. National Fire Protection Association (NFPA):
 - 70-23.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
 - 67-18.....Panelboards
 - 489-16.....Molded Case Circuit Breakers and Circuit
Breakers Enclosures
 - 891-19.....Dead-Front Switchboards
 - 1283-17.....Electromagnetic Interference Filters
 - 1449-21.....Transient Voltage Surge Suppressors

PART 2 - PRODUCTS

2.1 GENERAL

- A. Switchboards shall be in accordance with IEEE, NEMA, NFPA and UL, and as shown on the drawings. Switchboards shall be NEMA listed for the environment in which they are installed.
- B. Switchboards shall be provided complete, grounded, continuous-duty, integral assembly. Incorporate devices as shown on the drawing and as specified to render complete operation.
- C. Switchboards ratings shall not be less than shown on the drawings. Short circuit ratings shall not be less than the available fault current.
- D. All non-current carrying parts shall be grounded.
- E. Switchboard dimensions shall not exceed the dimensions shown on the drawings.
- F. Manufacturer's nameplate shall include complete ratings of switchboard in addition to the date of manufacture.

SPEC WRITER NOTES: Select the Type I or Type II switchboard as required for the specific project, and coordinate with circuit breaker type. Use fully rated circuit breakers if advantageous to Government.

2.2 BASIC ARRANGEMENT

//A. Type I: Switchboard shall be front accessible with the following features:

1. Device mounting:
 - a. Main breaker: Individually mounted and compartmented or group mounted with feeder breakers.
 - b. Feeder breakers: Group mounted.
2. Section alignment: As shown on the drawings.
3. Accessibility:
 - a. Main section line and load terminals: Front and side.
 - b. Distribution section line and load terminals: Front.
 - c. Through bus connections: Front and end.
4. Bolted line and load connections.//
5. Full height wiring gutter covers for access to wiring terminals.

//B. Type II: 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. Provide a completely enclosed, free standing, steel enclosure not less than the gage required by UL standards. The enclosure is to consist of the required number of vertical sections bolted together to form one metal enclosed rigid switchboard. The sides, top and rear shall be covered with removable screw on sheet steel plates.
- B. Provide ventilating louvers where required to limit the temperature rise of current carrying parts. All openings shall be protected against entrance of falling dirt, water, or foreign matter.

- C. Enclosure shall be thoroughly cleaned, phosphate treated, and primed with rust-inhibiting paint. Final finish coat to be the manufacturers standard gray. Provide a quart of finish paint for touch-up purposes.

2.4 BUSES

- A. General: Buses shall be arranged for 3-phase, 4-wire distribution. Main phase buses (through bus), full size neutral bus, and ground bus shall be full capacity the entire length of the switchboard. Provide for future extensions by means of bolt holes or other approved method. Brace the bus to withstand the available short circuit current at the particular location and as shown on the drawings. No magnetic material shall be used between buses to form a magnetic loop.
- B. Material and Size: Buses and connections shall be copper. Section busing shall be sized based on UL and NEMA Switchboard Standards.
- C. Bus Connections: All contact surfaces shall be copper. Provide a minimum of two plated bolts per splice. Where physical bus size permits only one bolt, provide a means other than friction to prevent turning, twisting or bending. Torque bolts to the manufacturer's recommended values.
- D. Neutral Bus: Provide bare or plated bus and mount on insulated bus supports. Provide neutral disconnect link to permit isolation of neutral bus from the common ground bus and service entrance conductors.
- E. Ground Bus: Provide an uninsulated 6 mm by 50 mm (1/4 inch by 2 inch) copper equipment ground bus bar sized per UL 891 the length of the switchboard and secure at each section.

SPEC WRITER NOTES: Include paragraph F only if the neutral is to be grounded at this point.

- //F. Main Bonding Jumper: Connect an uninsulated copper, //size as shown on the drawings// //6mm by 50mm (1/4 inch by 2 inches)//, shall interconnect the neutral and ground buses, when the switchboard is used to establish the system common ground point.//

2.5 MAIN CIRCUIT BREAKERS

- A. Type I Switchboard: Provide UL listed and labeled molded case circuit breakers in accordance with NEC and as shown on the drawings. Circuit breakers shall be the solid state adjustable trip type.
1. Trip units shall have field adjustable tripping characteristics as follows:
 - a. Long time pickup

- b. Long time delay.
 - c. Short time pickup.
 - d. Short time delay.
 - e. Instantaneous.
 - //f. Ground fault pickup.
 - g. Ground fault delay.//
2. Trip settings shall be as indicated on the drawings. Final settings shall be as shown on the electrical system protective device coordination study.
 3. Breakers, which have same rating, shall be interchangeable with each other.

SPEC WRITER NOTES: Select power type or molded case circuit breaker as required for the particular project.

B. Type II Switchboard:

- //1. Provide UL listed and labeled molded case circuit breakers in accordance with NEC and as shown on the drawings. Circuit breakers shall be the solid-state adjustable trip type.
 - a. Trip units shall have field adjustable tripping characteristics as follows:
 - 1) Long time pickup.
 - 2) Long time delay.
 - 3) Short time pickup.
 - 4) Short time delay.
 - 5) Instantaneous.
 - //6) Ground fault trip point.
 - 7) Ground fault trip delay.//
- b. Trip settings shall be as indicated on the drawings. Final settings shall be as shown on the electrical system protective coordination device study.
- c. Breakers, which have same rating, shall be interchangeable with each other. //

SPEC WRITER NOTES: Show breaker frame size, trip, voltage, interrupting rating, time bands and pick-up settings on the drawings.

2.6 FEEDER CIRCUIT BREAKERS

- A. Provide UL listed and labeled molded case circuit breakers, in accordance with the NEC, as shown on the drawings, and as herein specified.

SPEC WRITER NOTES: Select the desired non-adjustable or adjustable circuit breaker paragraph below.

//B. Non-adjustable Trip Molded Case Circuit Breakers:

1. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100 ampere frame size or less. Magnetic trip shall be adjustable from 3X to 10X for breakers with 600 ampere frame size and higher. Factory setting shall be LOW unless otherwise noted.
2. Breaker features shall be as follows:
 - a. A rugged, integral housing of molded insulating material.
 - b. Silver alloy contacts.
 - c. Arc quenchers and phase barriers for each pole.
 - d. Quick-make, quick-break, operating mechanisms.
 - e. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
 - f. Electrically and mechanically trip free.
 - g. An operating handle which indicates ON, TRIPPED and OFF positions.
 - h. Line and load connections shall be bolted.
 - i. Interrupting rating shall not be less than the maximum short circuit current available at the line.
 - j. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open. //

//C. Adjustable Trip Molded Case Circuit Breakers:

1. Provide molded case, solid state adjustable trip type circuit breakers.
2. Trip units shall have field adjustable tripping characteristics as follows:
 - a. Long time pickup
 - b. Long time delay.
 - c. Short time pickup.
 - d. Short time delay.
 - e. Instantaneous trip point.
 - //f. Ground fault trip point.
 - g. Ground fault trip delay.//

3. Trip settings shall be as indicated on the drawings. Final settings shall be shown on the electrical system protective device coordination study.
4. Breakers, which have same rating, shall be interchangeable with each other. //

//2.7 ELECTRIC UTILITY COMPANY EQUIPMENT

- A. Provide separate compartment for electric utility company metering equipment as shown on drawings.
- B. Provide suitable arrangements within the electric utility company metering compartment for mounting metering equipment. Obtain the electric utility company's approval of the compartment arrangements prior to fabrication of the switchboard.
- C. Allow access to electric utility company personnel as required for installation of utility metering equipment.//

//2.8 SURGE PROTECTIVE DEVICES (SPD)

- A. SPD shall be recognized, listed and tested in accordance with UL 1449. SPD shall also be UL 1283 listed.
- B. SPD shall be installed by and shipped from the electrical distribution equipment manufacturer's factory.
- C. SPD shall provide surge current diversion paths for all modes of protection; L-N, L-G, N-G, in WYE systems, and L-L, L-G in DELTA systems.
- D. SPD shall be modular in design. Each mode shall be fused with a 200kAIC UL recognized surge rated fuse and incorporate a thermal cutout device.
- E. SPD shall be integrally mounted to the bus bars of the switchboard.
- F. Audible diagnostic monitoring shall be by way of audible alarm. This alarm shall activate upon a fault condition. An alarm on/off switch shall be provided to silence the alarm. An alarm push to test switch shall be provided as well.
- G. SPD shall meet or exceed the following criteria:
 1. Maximum surge current capability (single pulse rated) per phase shall be:
 - a. Service Entrance Switchboard 250 kA.
 - b. Distribution Panelboards 160 kA
 - c. Branch Panelboards 160 kA
- H. SPD shall have the following diagnostic features: transient counter, status lights on each phase, and one set of 1 NO and 1 NC auxiliary dry contacts for alarm.//

//2.9 METERING

- A. Refer to Section 25 10 10, ADVANCED UTILITY METERING. Refer to drawings for meter locations.
- B. Provide current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.
- C. Provide voltage transformers including primary fuses and secondary protective devices for metering as shown on the drawings.//

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 12mm (1/2 inch) engraved lettered nameplates next to each circuit breaker. For Emergency Power system, provide laminated red phenolic resin with white core with 12mm (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 Emergency Power 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.

2.12 PROVISION FOR FUTURE

- A. Where "provision for", "future", or "space" is shown on the drawings, the space shall be equipped with bus connections to the future overcurrent device with suitable insulation and bracing to maintain proper short circuit rating. Provide buses for the ampere rating as shown on the drawings for the future device.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install the switchboard in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.
- B. Anchor switchboard to the slab with plated 12.5 mm (1/2 inch) minimum anchor bolts, or as recommended by the manufacturer.
- //C. In seismic areas, switchboard shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.//

SPEC WRITER NOTES: Mounting slab connections may have to be given in detail depending on the requirements for the seismic zone in which the equipment is located. Include construction requirements for concrete slab only if slab is not detailed in drawings.

- D. Exterior Location. Mount switchboard on concrete slab. Unless otherwise indicated, the slab shall be at least 200 mm (8 inches) thick, reinforced with a 150 mm (6 by 6 inch) No. 6 mesh placed uniformly 100 mm (4 inches) from the top of the slab. Slab shall be placed on a 150 mm (6 inch) thick, well-compacted gravel base. The top of the concrete slab shall be approximately 100 mm (4 inches) above the finished grade. Edges above grade 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. 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.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections and electrical tests:

1. Visual and Mechanical Inspection

- 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. Confirm correct operation and sequencing of electrical and mechanical interlock systems.
- g. Vacuum-clean switchboard enclosure interior. Clean switchboard enclosure exterior.
- h. Inspect insulators for evidence of physical damage or contaminated surfaces.
- i. Verify correct shutter installation and operation.
- j. Exercise all active components.
- k. Verify the correct operation of all sensing devices, alarms, and indicating devices.
- l. If applicable, 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 switchboard to ensure correct bus phasing from each source.

3.3 INSTRUCTION

- A. Furnish the services of a factory certified instructor for one 4-hour period for instructing personnel in the operation and maintenance of the switchboard and related equipment on the date requested by the Resident Engineer/COR.

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