

**SECTION 26 24 11  
DISTRIBUTION SWITCHBOARDS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

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

**1.2 RELATED WORK:**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlet boxes.
- C. Section 26 05 21, 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.

**1.3 FACTORY TESTS:**

- A. Design Tests: Design tests shall have been performed on a type or style of switchboard similar to that being furnished for this project. Tests shall be in accordance with NEMA PB 2 and UL 891.
- B. Production Tests: Dielectric, mechanical operation, grounding of instrument transformer cases, electrical operation and control wiring, and ground fault sensing equipment tests shall be performed on the switchboards provided for this project. Tests shall be in accordance with NEMA PB 2 and UL 891.

**1.4 SUBMITTALS:**

Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:

- A. Shop Drawings:
  - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 2. 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.
  - 3. 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.
- B. Manuals:
  - 1. 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.

- a. Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.
  - b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnection between the items of equipment.
  - c. Provide a clear and concise description of operation, which gives, in detail, the information required to properly operate the equipment.
  - d. Approvals will be based on complete submissions of manuals together with shop drawings.
2. Two weeks prior to final inspection, deliver four copies of the final updated maintenance and operating manuals to the C.O.R..
  - a. The manuals shall be updated to include any information necessitated by shop drawing approval.
  - b. Complete "As Installed" wiring and schematic diagrams shall be included which show all items of equipment and their interconnecting wiring.
  - c. Show all terminal identification.
  - d. Include information for testing, repair, trouble shooting, assembly, disassembly, and recommended maintenance intervals.
  - e. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
  - f. Furnish manuals in loose-leaf binder or manufacturer's standard binder.
- C. Certifications:
  1. Two weeks prior to final inspection, submit four copies of the following to the C.O.R.:
    - a. Certification by the Contractor that the assemblies have been properly installed, adjusted and tested, including circuit breakers settings.
    - b. Certified copies of all of the factory design and production tests, field test data sheets and reports for the assemblies.
- D. Manufacturer Seismic Qualification Certification: Submit certification that the switchgear, overcurrent protective devices, accessories, and components will withstand seismic forces at location being installed. Include the following:
  1. Basis of 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 equipment when subjected to the seismic forces as per specifications, and the unit will be fully operational after the seismic event."
  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.

## 1.5 APPLICABLE PUBLICATIONS:

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.

- A. Institute of Engineering and Electronic Engineers (IEEE):
  - C37.13-95.....Low Voltage AC Power Circuit Breakers Used in Enclosures
  - C57.13-93.....Instrument Transformers
  - C62.41-95.....Surge Voltage in Low Voltage AC Power Circuits
  - C62.45-02.....Surge Testing for Equipment connected to Low-Voltage AC Power Circuits
- B. National Electrical Manufacturer's Association (NEMA):
  - PB-2-01 .....Dead-Front Distribution Switchboards.
  - PB-2.1-02 .....Instructions for Proper Handling, Installation, Operation, and Maintenance of Switchboards
  - AB-1-02.....Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures
- C. National Fire Protection Association (NFPA):
  - 70-2011 .....National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
  - 67-93 .....Panelboards
  - 489-02 .....Molded Case Circuit Breakers and Circuit Breakers Enclosures
  - 891-98 .....Dead-Front Switchboards
  - 1283-98 .....Electromagnetic Interference Filters
  - 1449-96 .....Transient Voltage Surge Suppressors

## PART 2 - PRODUCTS

### 2.1 GENERAL:

- A. Switchboards shall be in accordance with UL, NEMA, NEC, IEEE, and as shown on the drawings.
- B. Switchboards shall be provided complete, ready for operation including, but not limited to housing, buses, circuit breakers, instruments and related transformers, fuses, and wiring.
- C. Switchboard dimensions shall not exceed the space provided as shown on the drawings.
- D. Manufacturer's nameplate shall include complete ratings of switchboard in addition to the date of manufacture.

### 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.
  6. Short Circuit Current Rating: 14,000 amperes rms, or as shown on the drawings, whichever is higher.
- 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. Short Circuit Current Rating: 14,000 amperes rms symmetrical, minimum, or as shown on the drawings, whichever is higher.

## **2.3 HOUSING:**

- A. Provide a completely enclosed, free standing, steel enclosure not less than the gage required by the ANSI and 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. Group the meters and their control switches on a hinged front cover. Provide concealed hinges and latch.
- D. 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 hard drawn copper of 98 percent conductivity. Bus temperature rise shall not exceed 65 degrees C (149 degrees F). 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.
- F. Main Bonding Jumper: Connect an uninsulated 6 mm by 50 mm (1/4 inch by 2 inch) copper bus between the neutral and ground buses to establish the system common ground point.

## **2.5 INTERNALLY INTEGRATED SURGE PROTECTIVE DEVICES:**

- A. Integral Surge Suppressor:
  - 1. SPD (Surge Protective Devices) shall be Component Recognized and listed in accordance with UL 1449 Second Edition to include Section 37.3 highest fault category testing on devices intended for service entrance use. SPD shall also be UL 1283 listed.
  - 2. SPD shall be UL 67 listed, installed by and shipped from the electrical distribution equipment manufacturer's factory.
  - 3. 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.
  - 4. 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.
  - 5. SPD shall be integrally mounted to the bus bars of the switchboard.
  - 6. 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.
  - 7. SPD shall meet or exceed the following criteria:
    - a. Maximum surge current capability (single pulse rated) per phase shall be:
      - 1) Service Entrance Switchboard 250 kA.
      - 2) Distribution Panelboards 160 kA
      - 3) Branch Panelboards 160 kA
      - 4) Service Entrance MCC 240 kA specified.
      - 5) Distribution Class MCC 160 kA

- b. UL 1449 Second Edition Listed and Recognized Component Suppression Voltage Ratings (SVR's)  
for Service Entrance and Distribution Location equipment shall not exceed the following:
- c. Voltage Let-Thru Values for Solidly Grounded Systems:

VOLTAGE	L-N	L-G	N-G
208Y/120	400V	400V	400V
480Y/277	800V	800V	800V

8. SPD shall have a minimum EMI/RFI filtering of –50Db at 100 kHz with an insertion ration of 50:1 using MIL-STD-220A methodology.
9. 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 alarming.
10. SPD shall have a warranty for a period of five years, incorporating unlimited replacements of suppressor parts if transients destroy them during the warranty period. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.

## **2.6 NAMEPLATES AND MIMIC BUS:**

- A. Nameplates: Provide laminated black phenolic resin with white core with 6 mm (1/4 inch) high engraved lettered nameplates for each circuit breaker (switch) to indicate the feeder, panelboards and equipment served. Mount, with plated screws, on front of the breaker.
- B. Mimic Bus: Provide an approved mimic bus on the front of the switchboard. Color to be blue (480Y/277 volt) or black (208Y/120 volt), either factory painted, plastic, or metal strips. Plastic tape shall not be used. Use symbols similar to a one line diagram. (Refer to drawings). Plastic or metal strips shall be mounted with plated screws.

## **2.7 METERS AND INSTRUMENT TRANSFORMERS:**

- A. Instrument Transformers: 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 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 5 KVA.
  4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondaries to ground overcurrent relays to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker ground-fault protection.

B. Power Circuit Monitoring and Control System: The Power Circuit Monitor shall be a multi-functional, digital, data acquisition and control device. The Power Circuit Monitor shall be metered over 50 values and extensive Min/Max data can be viewed on the LED display. Each Circuit Monitor shall offer true RMS metering and communications standard. Provide 0.2% accuracy true RMS metering and other powerful features such as automatic relay control, waveform capture, on-board event and data logging, and programmable logic for special applications like custom data logging and control function. On-board memory can be expanded to add 512 K or 1024K. Provide input/output modules, status inputs, a pulse output, relay outputs and analog inputs and outputs.

1. Power Circuit Monitor shall be
  - a. Certified ANSI C12.16 revenue accuracy
  - b. True RMS Metering through the 31<sup>st</sup> harmonic
  - c. High accuracy: 0.2% on current and voltage
  - d. Power quality readings displayed: THD and K-Factor
  - e. Harmonic Analysis Data through 63<sup>rd</sup> harmonic
  - f. Automatic Alarm/Relay control
  - g. On-board event and data logging
  - h. Waveform capture
  - i. UL listed, CSA Approved, CE Marketing, NOM Approved
  - j. MV-90 compatible

G. Recording Demand Meter: Usable as totalizing relay or as indicating and recording maximum-demand meter with 15-minute interval. Meter shall count and control a succession of pulses entering two channels. House in drawout, back-connected case arranged for semiflush mounting.

## **2.8 PROVISION FOR FUTURE:**

Where "provision for", "future", or "space" is noted on 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 and physical clearance. Provide buses for the ampere rating as shown for the future device.

## **2.9 BREAKER REMOVAL EQUIPMENT:**

Where draw out circuit breakers are provided, furnish a portable elevating carriage or switchboard mounted device for installation and removal of the breakers.

## **2.10 CONTROL WIRING:**

Control wiring shall be 600 volt class B stranded SIS. Install all control wiring complete at the factory adequately bundled and protected. Wiring across hinges and between shipping units shall be Class C stranded. Size in accordance with NEC. Provide control circuit fuses.

## **2.11 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. Ampere setting (continuous).
    - b. Long time band.
    - c. Short time trip point.
    - d. Short time delay.
    - e. Instantaneous trip point.
    - f. Ground fault trip point.
    - g. Ground fault trip delay.
  2. Trip settings shall be as indicated on the drawings. Final settings shall be as shown on the electrical system protective device study.
  3. Breakers, which have same rating, shall be interchangeable with each other.
- 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) Ampere setting (continuous).
      - 2) Long time band.
      - 3) Short time trip point.
      - 4) Short time delay.
      - 5) Instantaneous trip point.
      - 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 device study.
    - c. Breakers, which have same rating, shall be interchangeable with each other. /

## **2.12 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.
- 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.

### **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 to the floor with plated with 12.5 mm (1/2 inch) minimum anchor bolts as recommended by the manufacturer. Anchor the switchboards on two 100 mm (4 inch) minimum channel iron sills with plated 12.5 mm (1/2 inch) bolts. Furnish sills to suit the switchboards. Coordinate installation of sills with concrete pour of floor. Sills shall be level and grouted flush with floor.
- C. Seismic bracing for switchgear shall be in accordance with the details shown on the drawings.

#### **3.2 INSTRUCTIONS**

Furnish the services of a competent instructor for one 4 hour period for instructing personnel in the operation and maintenance of the switchboard on the date requested by the C.O.R..

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