

T-Plant 480V Switchboards Procurement Specification

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract 89303320DEM000030



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Release Approval

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1.0 SCOPE

This specification provides the requirements for manufacturing and supply of a pair of 480-Volt, 3 phase, 2000 Amp, 65 kA SCCR/AIC, B-Phase corner grounded Δ connected switchboards.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of the Basis of Design to the extent specified in the applicable sections of this document. In the event of a conflict between documents referenced herein and the requirements of this specification, the requirements of this specification shall take precedence.

This specification along with the documents specified in this Section and, as identified in Sections 2.1 and 2.2, provide the requirements for supplying two 480-Volt, B-Phase corner grounded Δ connected switchboards.

2.1 Government Documents

US Department of Energy, Richland Operations Office – Drawing H-2-841273-001, 13.8 kV One Line Diagram Buildings 221T and 271T, H-2-841273-017, E-SWBD-N17-001 Construction Detail and H-2-841273-018, E-SWBD-N07-002 Construction Detail.

2.2 Non-Government Documents

The codes and standards are listed below, the latest versions shall be used.

American Society of Civil Engineers (ASCE)

ASCE/SEI 7-10 Minimum Design Loads for Buildings and Other Structures

Institute of Electrical and Electronics Engineers (IEEE)

IEEE C37.13	Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.16	Low-Voltage Power Circuit Breaker and AC Power Circuit Breaker Protectors-Preferred Ratings, Related Requirements and Application Recommendations
IEEE C37.17	Trip Devices for AC and General Purpose DC Lo-Voltage Power Circuit Breaker
IEEE C37.20.1	Standard for Metal-Enclosed Low-Voltage (1000 Vac and below, 3200 Vdc and below) Power Circuit Breaker Switchgear
IEEE C37.50	Test Procedures for Low-Voltage (AC) Power Circuit Breaker Used in Enclosures
IEEE C57.13	IEEE Standard Requirements for Instrument Transformers
IEEE C62.41.1	Surge Environment in Low-Voltage (1000V and less) AC Power Circuits

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IEEE C62.45 Surge Testing for Equipment connected to Low Voltage AC Power Circuits

IEEE-141 Electric Power Distribution for Industrial Plants

National Electrical Manufacturers Association (NEMA)

NEMA AB 3 Molded Case Circuit Breakers and Their Application

NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches

NEMA PB2 Deadfront Distribution Switchboards

NEMA PB 2.1 Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less

NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)

ANSI/NEMA Z535.4 Product Safety Signs and Labels

Underwriters Laboratories Inc. (UL)

UL 489 Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

UL 891 Switchboards

UL 1066 UL Standard for Safety Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures

National Fire protection Association (NFPA)

NFPA 70 National Electrical Code

3.0 TECHNICAL REQUIREMENTS**3.1 General**

1. The switchboards shall comply with the codes and standards cited in Section 2.2.
2. The switchboards shall be a complete, 480-Volt, 3 phase, B-Phase corner grounded Δ , continuous duty, integral assembly, dead front, dead rear self-supporting, outdoor rated NEMA 3R assembly with the general arrangement and related components as shown on drawings H-2-841273-001, 13.8 kV one line diagram, H-2-841273-017, Switchboard E-SWBD-N17-001 and H-2-841273-018, Switchboard E-SWBD-N07-002.
 - a. Equipment short circuit current ratings (SCCR) and the rating of circuit breaker supplied are to be a minimum of 65 KA (SCCR/AIC).
 - b. Switchboard configuration shall conform to the arrangements and details shown on drawings H-2-841273-001, H-2-841273-017 and H-2-841273-018.

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- c. Kirk-Key type mechanical interlocks shall be provided to allow connection of the two switchboards via tie breakers in each switchboard without paralleling of the two incoming switchboard power sources as follows:
 - 1) Tie breakers in both switchboards can be in closed position at the same time only when the main breaker in only one of the switchboards is in closed position while the other main breaker is in Open and/or in a racked-out position.
- d. The switchboards are to be completely assembled, connected, and wired at the factory so that only external source/load connections are required at the installation site.
- e. Packaging shall provide adequate protection against handling during shipment.

3.2 Arrangement

- 1. The switchboards arrangement shall be as shown on drawings H-2-841273-001, H-2-841273-017 and H-2-841273 018. Exceptions proposed to this arrangement, with justification may be considered with the buyer's concurrence.
- 2. The switchboards shall be front accessible with the following features.
 - a. Main circuit breakers individually mounted and compartmented.
 - b. Main circuit breakers and the switchboards shall be service rated and or suitable as service equipment.
 - c. Tie Circuit breakers individually mounted and compartmented.
 - d. Feeder breakers may be group mounted.
 - e. Supply cable entries for switchboard E-SWBD-N17-001 shall be from the bottom. Supply cable entries for switchboard E-SWBD-N07-002 shall be from the top. If top entry is not recommended by the manufacturer, The Supplier is to provide alternate configurations, extended wireway additions for side or back entry. All other requirements remain the same for both switchboards specified.
 - f. Supply power entry, load feeders and Tie breaker connections shall enter/exit from the top/bottom only, as applicable, per switchboard unless provisions in 3.2 (2)(e) is provided in lieu of top entry requirement.

3.3 Enclosure

- 1. The switchboards shall be braced with reinforcing gussets using jig welds or bolted connections to assure rectangular rigidity.
- 2. The enclosures shall be outdoor rated, NEMA 3R service leveled and the housing enclosure thickness shall not be less than the minimum gauge required by the applicable codes and standards cited in Section 2.2.
- 3. Die-pierced the holes for connecting adjacent structures to ensure proper alignment and to allow for future additions.
- 4. All bolts, nuts, and washers shall be zinc or cadmium plated steel with proper alignment and to allow for future additions.

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5. The switchboards are to be completely metal enclosed, self-supporting, dead front, free standing, and circuit breakers type shall be rated for outdoor service that complies with NEMA PB2 and UL listed in accordance with UL891.
6. Space heaters are to be supplied for each section of the switchboard. Power for the space heaters shall be internally supplied with all accessories i.e., thermostat, control power transformer, fusing, wiring etc. The space heater shall have indicator lights mounted on front of the SWBD indicating the heater ON/OFF status.
7. SWBDs shall have hooks/eye bolts, etc. on the top to accommodate lifting the assembly using cranes.
8. SWBDs shall be equipped with Voltage & Current meters/displays on the front face of the SWBD, clearly indicating the voltage/current on each phase.
9. The switchboards shall be designed for bottom entry/exit for one of the switchboards and top entry/exit for the other unless configured as proposed in 3.2.2 (e). Bottom/Top removable plates, as applicable, shall be provided to enable the installation contractor to drill and punch openings for installing conduit hubs to route cables into and out of the new switchboards.

3.4 Finish

1. The interior/exterior finish shall be light gray.

3.5 Buses

1. Provide silver plated copper phase buses, fully rated for 2000 amps, as shown on drawing H-2-841273-001 for the entire length of the switchboard.
2. Mount buses on appropriately spaced insulators and brace to withstand the available short circuit currents of 65 KA.
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. All bolts, nuts and washers shall be zinc plated/cadmium plated steel. Bolts are to be torqued to the values recommended by the manufacturer.

3.6 Main and Tie Circuit Breakers

1. 2000-Amp frame main and tie breakers shall be insulated case 100% rated as shown on drawing H-2-841273-001. The circuit breakers shall be supplied with solid state adjustable LSI trip type units. Trip units are to be operable without the need of an external power supply.
 - a. Trip units shall have field adjustable tripping characteristics as follows:
 - 1) Long time pickup
 - 2) Long time delay
 - 3) Short time pickup

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- 4) Short time delay
 - 5) Instantaneous
 - 6) Ground fault
- b. 2000 Amp frame Main and Tie breakers are to be able to accept up to four (4) 600 MCM cables per phase.
 - c. The main breakers shall be equipped with arc flash reduction capabilities, meeting NFPA 70 (NEC) Article 240.87 requirements.

3.7 Feeder Circuit Breakers

1. 800-Amp, and 400-Amp frame feeder breakers shall be molded case 100% rated as shown on drawing H-2-841273-001. The circuit breakers shall be supplied with solid state adjustable trip type units. Trip units are to be operable without the need of an external power supply.
 - A. Trip units shall have field adjustable tripping characteristics as follows:
 - Long time pickup
 - Long time delay
 - Short time pickup
 - Short time delay
 - Instantaneous
2. 800AF/400AT and larger breakers lugs shall be capable of accepting a minimum set of two parallel conductors.
3. The breakers voltage ratings shall be fully rated for 480V or 600V. No slashed rated breakers (i.e., 480/277) will be accepted.

3.8 Identification

- Provide engraved laminated nameplate for each SWBD.
- The nameplate shall be located at eye level on the front cover of the switchboard incoming service section.

3.9 Control Wiring

- Secure wires in bundles using nylon ties; anchor bundles to the switchboard assembly using pre-punched wire lances.
- Connect current transformer secondary leads to accessible short-circuiting terminal blocks (via test switches) before connecting to any other device.
- Terminate control and communications conductors on terminal blocks with suitable numbering strips; use crimp-on solderless lugs.

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- Provide wire markers at each end of all control and communications wiring.

3.10 Surge PROTECTION

- SWBDs shall be equipped with Surge Protective Devices

3.11 Switchboard Accessories

Provide the following accessories:

1. Provide portable, floor supported, elevating carriage with roller base, for movement of circuit breakers in and out of switchboard structure. Provide appropriate lifter bars and attachments for lifting circuit breakers (only one for both switchboards)
2. Main and feeder breaker tester equipment with all connecting cables and power supply for periodic testing of the circuit breakers (only one tester for both switchboards)

3.12 Reliability

Vendor to provide written warranties for performance of the equipment, indicating the warranty duration and provide with customer support access during the warranty period.

3.13 Maintainability

The new switchboards are to be maintainable. Breakers, buses, and equipment shall be easily serviceable. Removable panels shall be provided to access breakers and access the solid-state trip units without dismantling the switchboard. All doors shall open easily and be accessible for maintenance. Access to cable connections shall be easily accessible for inspection and to perform testing. Vendor shall submit a list of recommended spare part for each switchboard.

3.14 Environment

The switchboards are to be located outdoors and capable of operating under the following conditions:

- Temperature: 15.0 Deg. F to 104 Deg. F
- Humidity: 100%.
- Wind: Require 115 MPH.
- Elevation: 732'.

3.15 Transportability and Storage

If approved by the Buyer, the switchboards may be broken down into convenient shipping sections after the completion of the tests. Separate shipping split terminals shall be provided, and connections disconnected for shipping shall be properly identified. Vendor shall provide all shipping and installation information including pallet sizes, weights, and heights. Vendor shall also provide storage information. The equipment shall be securely wrapped, packaged, and

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labeled for each unit for safe handling during shipment. The equipment shall be braced and packaged for handling. Any internal temporary bracing shall be clearly labeled "To be removed before operation."

3.16 Safety

The equipment is to be rated for a corner B-Phase grounded Δ system. Equipment and switchboards are to be properly labeled for this type of service meeting all applicable NFPA 70 Labeling/marketing/color coding requirements.

3.17 Parts/Materials/Processes

The switchboards are to be rated NEMA 3R construction. All parts and materials shall be new. All breakers shall be tested prior to being installed in the switchboards.

3.18 Cleanliness

The switchboards are to be completely cleaned prior to shipment. The units shall be free of all debris and be suitably protected for shipment.

3.19 Protective Coatings

Any painted parts within the switchboards shall utilize the standard vendor's coatings. Vendor to supply a can of touch up paint with the product.

3.20 Interchangeability

Switchboard components of like breaker frame sizes and solid-state tripping units shall be interchangeable between the two switchboards.

3.21 Nameplate

A nameplate shall be installed on each switchboard with the Owner's tag number as well as all pertinent switchboard ratings including the requirement that the switchboards are designed for a B-Phase corner grounded Δ supply. Warning signs shall be mounted on each entrance door of the outdoor switchboard enclosures. They shall be clearly a clearly lettered warning sign for warning personnel. The signs shall be attached with stainless steel screws. Nameplates shall be mounted with stainless steel screws on front of breakers or on equipment enclosure next to breakers. Mounting nameplates only with adhesive is not acceptable.

3.22 Human Engineering

All breakers shall be easily identified and easily operable and or be capable of removal for service as applicable.

3.23 Document Submittal**3.23.1 The following documents shall be submitted at time of bid.**

1. Circuit breaker types, sizes, and ratings.
2. Switchboard layout/arrangement drawings.

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3. Catalog cut sheets of all equipment to be supplied.
4. Interlock design and sequence of operation discussion.
5. Switchboard Dimensional drawings.
6. Switchboard alternate conduit entry configurations as cited in Section 3.2.2e.
7. Cable entry and exit drawings.
8. Equipment estimated weights.
9. Document submittal Schedule for documents cited in Section 3.23.2.
10. Vendor warranty information including duration and customer support access as cited in Section 3.12.
11. Equipment manufacturing schedule.

3.23.2 The following documents are to be submitted with the product and at the time of delivery.

- Catalog Data: Submit catalog data describing each type switchboard, circuit breaker, metering, accessory item, and component specified. Include data substantiating that materials comply with specified requirements.
- Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, installation, and starting of Product.
- Operation and Maintenance Instructions: Submit operation and maintenance instructions including inspection and maintenance test procedures and a listing of recommended spare parts. Include instructions for testing circuit breakers.
- Recommended spare parts list as cited in Section 3.13.
- Pre-Installation Storage Requirements as cited in Section 3.15.

- Shop Drawings: Submit shop drawings for each switchboard including dimensioned plans and elevations and component lists. Include front and side views of enclosure showing overall dimensions, enclosure type, enclosure finish, unit locations, and conduit entrances. Include the following:
 - Front, side, and plan view of the switchboards.
 - Single line or three-line diagrams.
 - Nameplate schedule.
 - Component lists.
 - Conduit entry locations.
 - Busway entry locations and details.
 - Switchboard ratings including short circuit, voltage, and current.
 - Major component ratings including voltage, current, and interrupting.
 - Cable terminal sizes and types.
 - Bus configuration and current ratings.
 - Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

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3.24 Personnel and Training

Vendor shall offer separate pricing for the training of Owner's personnel for operating /maintenance of the specified equipment with their bid. Buyer may or may not procure this service at its discretion.

4.0 QUALITY ASSURANCE REQUIREMENTS

As identified in Section 4.1.1, a certificate of conformance with this specification is required to be submitted that the switchboards conform to the requirements of this specification.

4.1 General

The Buyer may request, and the vendor shall allow for a Buyer's representative to attend, inspect, and witness the final testing and inspection of the equipment at the vendor's manufacturing site prior to shipment. The Vendor is to notify the Buyer 2 weeks in advance to schedule this final witness testing and inspection.

4.1.1 Certificate of Conformance

The vendor is responsible for providing a certificate of conformance clearly indicating that the equipment being supplied meets this specification. Equipment test data after reviewed and approved by the Vendor is to be submitted to the Buyer for approval.

4.2 Inspections and Tests

- A. Factory Tests shall be performed, and test reports will be requested by the Buyer and shall be provided by the vendor.
- B. Factory Tests shall include but not be limited to the following:
 - 1. Tests shall be conducted per NEMA PB 2 including those specifically for B phase corner-grounded Δ connected system as applicable.
 - 2. Verify circuit breaker sizes and types correspond to the drawings.
 - 3. Verify tightness of bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 - 4. Confirm correct operation and sequencing of the interlock system for circuit breakers by attempting closure on locked-open devices and attempting to open locked-closed devices as applicable.
 - 5. Perform an insulation-resistance test, phase to ground on each bus section in accordance with manufacturer's published data.
 - 6. Perform insulation-resistance tests on control wiring with respect to ground.

5.0 PREPARATION FOR DELIVERY**5.1 General**

Contact the Buyer's technical representative (BTR) 3 weeks in advance to inform of the delivery scheduled date. Make proper and final arrangements with the BTR for delivery instructions.

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5.2 Preservation and Packaging

Equipment to be packed and properly protected prior to shipment to avoid shipping damage. Damaged equipment will not be accepted.