**SECTION 26 24 13**

**SWITCHBOARDS**

**BASED ON DFD MASTER ELECTRICAL SPEC DATED 03/01/23**

This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.

***For switchboard installations, perform fault current calculations and record available fault current values on one-line diagram. The one-line diagram shall meet IEEE standards.***

***This specification covers the UL type switchboards used in typical building projects. Do not use this specification for ANSI type low voltage switchgear with draw out circuit breakers. If required for a special application, the consultant will need to develop a separate specification for ANSI type low voltage draw out switchgear.***

**PART 1 - GENERAL**

**SCOPE**

The work under this section includes main and/or distribution switchboard(s) specified herein and shown on the Drawings. Included are the following topics:

PART 1 - GENERAL

 Scope

 Related Work

 References

 Submittals

 Operation and Maintenance Data

 Delivery, Storage, and Handling

 Extra Materials

PART 2 - PRODUCTS

 Switchboard Construction and Ratings

 Pull Box

 Pull Section

 Main Circuit Breaker

 Main Fusible Switch

 Circuit Breaker Distribution Sections

 Fusible Distribution Sections

 Coordination of Overcurrent Protective Devices

 Instruments and Sensors

 Surge Protective Devices

PART 3 - EXECUTION

 Installation

 Field Quality Control

 Adjusting

 Construction Verification Items

 Agency Training

**RELATED WORK**

Applicable provisions of Division 1 govern work under this section.

Section 26 05 73- Short Circuit/Coordination Study and Arc Flash Risk Assessment

Section 26 27 13 – Electricity Metering

Section 26 43 13 - Surge Protective Devices for Low Voltage Electrical Power Circuits

Section 26 08 00 - Commissioning of Electrical

Section 01 91 01 or 01 91 02 – Commissioning Process

**REFERENCES**

ANSI C57.13 – Instrument Transformers

NEMA AB 1 ‑ Molded Case Circuit Breakers

NEMA KS 1 ‑ Enclosed Switches

NEMA PB 2 ‑ Dead Front Distribution Switchboards

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

UL-891 ‑ Dead Front Switchboards

**SUBMITTALS**

Include plan and elevation layouts showing overall dimensions and compartment layout with available spaces; conduit entrance locations and requirements; nameplate legends; one-line diagrams; size and number of bus bars per phase, neutral, and ground; switchboard instrument details; instructions for handling and installation of switchboard; and electrical characteristics including voltage, frame size and trip ratings, withstand ratings, time‑current curves, and interrupting ratings confirming a fully-rated system for all equipment and components.

Submit the required coordination study and the overcurrent device set point recommendations to the consulting engineer for review and approval. Submittal shall be on or before date of switchboard and panelboard equipment submittal.

Documentation shall be provided for Arc Energy Reduction where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated or can be adjusted is 1200A or higher.

# OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

* 1. Bus tightening intervals and procedures
	2. Overcurrent protective device testing and maintenance procedures
	3. Coordination study and the overcurrent device set point recommendations
	4. Field report noting final adjustments to overcurrent protective device settings

**DELIVERY, STORAGE, AND HANDLING**

Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

Handle in accordance with NEMA PB2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

**EXTRA MATERIALS**

Submit one set of spare fuses of each size and type used in the equipment provided.

**PART 2 - PRODUCTS**

**SWITCHBOARD CONSTRUCTION AND RATINGS**

Switchboard electrical rating and short circuit current rating shall be as shown on the Drawings and as required by short circuit/coordination study.

The switchboard and overcurrent devices contained within shall be **fully-rated**.

Main Section Devices: Individually mounted.

Distribution Section Devices: Group-mounted and/or individually mounted, complete with bus in an integrated assembly. All breakers shall be bolted, quick-make, quick-break, trip indicating and common trip on all multi-pole breakers. No handle ties will be permitted.

Buses:

The switchboard bussing (and all other current carrying parts such as fingers, neutral and ground buses) shall be plated copper. The bussing shall be of sufficient cross-sectional area to meet UL 891 temperature rise requirements.

For 4-wire systems, the neutral bus shall be the equivalent ampacity as the phase bus bars.

Provide a copper ground bus through the length of the switchboard sized per UL 891 and NFPA requirements. Bus shall be predrilled for two hole, bolt type mechanical connections.

Ground bus shall be continuous throughout the length of the switchboard. Factory supplied bus jumpers shall be utilized for field connection of ground bus between shipping splits. Field fabricated jumpers are not permitted.

Distribution sections shall be fully bussed and fully equipped for the future breakers, including all connectors and mounting hardware.

Line and load terminations shall be rated for the size, number of conductors and conductor material.

Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials used.

Enclosure:

Factory assembled, dead front, metal‑enclosed, and self‑supporting switchboard assembly conforming to NEMA PB2, and complete from incoming line terminals to load side terminations.

All closure plates shall be screw removable and small enough for easy handling by one person.

Finish: Manufacturer's standard medium gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion resistant paint, or plate with cadmium or zinc.

Enclosure shall be NEMA PB 2 Type [1 ‑ General Purpose.] [3R ‑ Raintight.]

[Front][Front and Rear] accessible only.

Provide Infrared inspection window to inspect line and load side termination lugs of individually mounted main OCPD.

The center grip of the operating handle of all switches or circuit breakers, when at its highest position, shall not be more than 6 feet 3-1/2 inches high in the switchboard enclosure. Note: The switchboard is mounted on a 3-1/2 inch housekeeping pad equal to 6 feet - 7 inches maximum operating handle height above floor.

[Provide metering transformer compartment for Utility Company's use. Compartment size, location, bus spacing and drilling, door, and locking and sealing requirements shall meet the requirements of the local utility company. Compartment shall be in compliance with local utility service requirements.]

**PULL BOX (TOP HAT)**

Same construction as switchboard, width and depth to match switchboard. The top and sides shall be removable.

***The following Pull Section is not a design team option and shall be provided for all new construction switchboards and highly desired for all new/ replacement installations in existing buildings. If space is limited with in existing building, review with DFD electrical team prior to deleting requirement. Verify equipment submittal to ensure pull section is included in switchgear lineup.***

**PULL SECTION**

Same construction as switchboard, width, depth and height to match switchboard. The top and sides shall be removable.

Provide a pull section on all switchboards fed with incoming cables.

Compartment shall include switchboard bus extension drilled and tapped for the incoming cable terminations.

Compartment width shall be minimum [24”] [30”] [36”] [42”].

**MAIN CIRCUIT BREAKER**

The main circuit breaker in 208V switchboards shall be an individually mounted and bussed molded case circuit breaker, [80%] [100%] rated [, with a full function electronic trip unit].

The main circuit breaker in 480V switchboards shall be an individually mounted and bussed molded case circuit breaker, [80%] [100%] rated, with a full function electronic trip unit.

Individually mounted mains shall be located in the middle of an individual section Provide minimum distance between cable entry opening and termination lugs of main OCPD per manufacturer [and local utility].

Provide Infrared inspection window to inspect line and load side termination lugs of individually mounted main OCPD.

Ground fault protection shall be included at the main disconnect for 480/277volt switchboards 1000 amperes and larger. Ground fault trip shall be of the residual type and an integral part of the breaker. The ground fault system shall include a memory circuit for positive tripping action despite intermittent arcing ground faults. Provide an integral means of testing the ground fault system to meet the on-site testing requirements of NEC Article 230-95(c).

Provided for Arc Energy Reduction where the highest continuous current trip setting for which the actual overcurrent device installed is rated or can be adjusted 1200A or higher.

**MAIN FUSIBLE SWITCH**

Individually mounted bolted pressure type fuse switch. Switch shall be UL listed for 100% of the continuous rating without exceeding 60 degree C. rise over a maximum 40 degree C. ambient.

Switch shall be furnished with Class L fuse clips and be UL listed for 200,000 amps interrupting capacity.

Switch shall utilize stored energy dead front operating mechanism to provide quick positive switching independent of the speed of the operating handle. Switch shall be manually operated [and electrically tripped].

Fuse access door shall be mechanically interlocked with the operating handle and shall have provisions for locking in the open position.

Individually mounted mains shall be located (top, middle or bottom) per manufacturers requirements based on location of cabling entrance into section. Provide minimum distance between cable entry opening and termination lugs of main OCPD per manufacturer [and local utility].

Provide Infrared inspection window to inspect line and load side termination lugs of individually mounted main OCPD.

***Include the following for electrically tripped.***

Electrically tripped switch shall be closed after the opening spring has been charged ready for electrical opening by the solenoid or manual opening by the mechanical pushbutton.

***Include the following as required for electrically tripped.***

Supply the following accessories with the switch:

Ground fault protection with test panel for 480/277volt switchboards 1000 amperes and larger. Ground fault trip shall be of the residual type and include a memory circuit for positive tripping action despite intermittent arcing ground faults. Provide an integral means of testing the ground fault system to meet the on-site testing requirements of NEC Article 230-95(c).

Protection which shall open the switch upon loss of phase by the utility.

Blown fuse protection to open the switch upon operation of one or more fuses.

Provided for Arc Energy Reduction where the highest continuous current trip setting for which the actual overcurrent device installed is rated or can be adjusted is 1200A or higher.

**CIRCUIT BREAKER DISTRIBUTION SECTIONS**

Distribution circuit breakers shall be group mounted in frame sizes 100 amp through 1200 amp. Frame sizes larger than 1200 amp shall be individually mounted.

Frame sizes larger than 1200 amp, individually mounted circuit breakers shall be provided with infrared inspection windows to inspect line and load side termination lugs. Mounting locations shall allow for front inspection.

The circuit breakers are to be totally front accessible and mounted in the switchboard to permit installation, maintenance and testing without reaching over line side bussing. The circuit breakers are to be removable by the disconnection of only the load side terminations and line and load side connections are to be individual to each circuit breaker. Common mounting brackets or electrical bus connectors are not acceptable.

Circuit breakers shall be provided with provisions for mounting handle padlock attachments.

Breaker feeder lugs shall be dual rated for use with either aluminum or copper conductors.

Each circuit breaker is to be furnished with an externally operable mechanical means to trip the circuit breaker, enabling maintenance personnel to verify the ability of the circuit breaker trip mechanism to operate, as well as exercise the circuit breaker operating mechanisms.

A minimum of 20% future circuit breaker spaces shall be included. Spaces for future circuit breakers shall be “prepared” spaces. These spaces shall be provided with the necessary mounting hardware and bus extensions so that when future breakers are added, only the breaker itself needs to be purchased by the installer.

Circuit breakers in 480V switchboards shall be fully adjustable LSI circuit breakers with electronic trip for frame sizes 400A and greater. When ground fault protection is required on the main overcurrent device, fully adjustable LSIG circuit breakers with electronic trip units shall be provided for feeder circuit breaker frame sizes 400A and greater.

Circuit Breakers:

Electronic Trip Circuit Breakers: As scheduled on the drawings, electronic circuit breakers shall have, at a minimum, adjustments for long time, short time and instantaneous trip. Provide integral ground fault sensing with adjustable ground fault trip where indicated on the drawings.

Molded Case Circuit Breakers: As scheduled on the drawings, integral thermal and instantaneous magnetic trip elements in each pole.

Provided for Arc Energy Reduction where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated or can be adjusted is 1200A or higher.

**FUSIBLE DISTRIBUTION SECTIONS**

Fusible switches shall be quick make, quick break and shall be group mounted in panel type construction. Switches of 30 amperes to 200 amperes shall have plug‑on line side connections. Each switch is to be contained in a separate steel enclosure. The enclosure shall employ a hinged cover for access to the fuses which shall be interlocked with the operating handle to prevent opening the cover when the switch is in the "ON" position.

This interlock shall be constructed so that it can be released with a standard electrician's tool for testing fuses without interrupting service. Units shall have padlocking provisions in "OFF" position and operating handle position shall give positive switch position indication, i.e. red for "ON" and black for "OFF". Switches shall pass industry standard I2t with-stand tests and fuse tests.

A minimum of 20% future fusible switch spaces shall be included. Spaces for future fusible switches shall be “prepared” spaces. These spaces shall be provided with the necessary mounting hardware and bus extensions so that when future fusible switches are added, only the fusible switch itself needs to be purchased by the installer.

***The set points for the overcurrent and ground fault trip adjustments must be addressed. This specification shall require that the set point recommendations be provided by including the following paragraph (unless the consultant would prefer to provide them). Upon completion of the construction, the consultant shall field verify that the overcurrent devices have been properly set. Also verify that the coordination study and set point recommendations have been included in the O&M manual.***

**COORDINATION OF OVERCURRENT PROTECTIVE DEVICES**

Provide a coordination study of the electrical system and recommend set points for all of the overcurrent and ground fault trip adjustments on the equipment provided. The coordination study and set point recommendations shall be submitted to the consulting engineer for approval. Submittal shall be on or before date of switchboard and panelboard equipment submittal. The study shall meet the requirements of specification section 26 05 73.

**INSTRUMENTS AND SENSORS**

Provide an electronic meter (with meter test switch and instrument transformers) for Owner’s use in the switchboard. Meter and related equipment shall meet the requirements of specification section 26 27 13.

**SURGE PROTECTIVE DEVICE**

Provide a surge protective device meeting the requirements of specification section 26 43 13. Surge protective devices shall be served from an overcurrent protective device within the switchboard.

Surge protective device shall be installed external to the switchboard.

**PART 3 - EXECUTION**

**INSTALLATION**

Install switchboard in locations shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1.

Install switchboard on a 3.5 inch high concrete equipment pad.

Install 90 degree C insulated conductors based on ampacity of 75 degree C conductors when utilizing 100% rated OCPD’s. Consult manufacturer’s requirements for specific devices.

Tighten accessible bus connections and mechanical fasteners after placing switchboard per manufacturer’s requirements.

**FIELD QUALITY CONTROL**

Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

Check tightness of accessible bolted bus joints using a calibrated torque wrench. Tightness shall be in accordance with manufacturer's recommended values.

Measure insulation resistance of each bus section phase to phase and phase to ground for one minute each. Test voltage shall be 1000 volts, and minimum acceptable value for insulation resistance is 2 megohms.

[Ground-fault protection system shall be performance tested on site utilizing factory qualified personnel using a test process of primary current injection.]

Touch up scratched or marred surfaces to match original finish.

**ADJUSTING**

Adjust all operating mechanisms for free mechanical movement.

Adjust trip and time delay settings to values as recommended in coordination study or as instructed by the A/E. Include a copy of the coordination study and recommended circuit breaker set points in the O&M manual.

**CONSTRUCTION VERIFICATION**

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

# AGENCY TRAINING

All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

END OF SECTION