SECTION 26 24 13
SWITCHBOARDS

PART 1 - **GENERAL**

1.1 DESCRIPTION

A. Provide switchboards in accordance with the Contract Documents.

B. Switchboards include both main switchboards and distribution switchboards.

1.2 QUALITY ASSURANCE

A. Utility company approval of service busway, incoming section, and metering provisions.

1.3 REFERENCE STANDARDS

A. Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

B.

C. NEMA – National Electrical Manufacturers Association
   1. NEMA PB 2 Deadfront Distribution Switchboards
   2. NEMA AB 1 Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures

D. UL – Underwriters Laboratories Inc.
   1. UL 489 Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
   2. UL 891 Switchboards
   3. UL 977 Standard for Fused Power-Circuit Devices
   4. UL Service Entrance Label

E. Federal Specifications
   1. W-C-375 Circuit Breakers, Molded Cast; Branch Circuit and Service

F. NETA – InterNational Electrical Testing Association

G. Utility company requirements.

1.4 SUBMITTALS

A. Manufacturer’s product data sheets for overcurrent protection devices.

B. Dimensioned layout and elevation drawings showing switchboards, housekeeping pads, and support locations and types.

C. One-line diagram showing electrical ratings, overcurrent protection device ratings, cable lugs, utility company metering, metering displays, identification nameplate, and fuse clip sizes.

D. Utility company approval for components subject to their specifications.

E. Wiring diagrams.

F. Installation instructions.

G. Arc flash study.

H. Short circuit and coordination study.

I. Certified test reports.

J. Seismic restraint calculations.

1.5 FIELD TESTING

A. Field-inspection and -testing shall occur after installation is complete, feeders are terminated, and the room is secure. Testing shall be conducted not more than four weeks before equipment is energized.

B. Testing Scope:
1. Visual and physical inspection of equipment.
2. Check control wiring and metering.
3. Meter calibration.
4. Ground fault protection.
5. Adjust circuit breaker settings based on recommendations in the short circuit and coordination study.
6. Primary current injection testing of circuit breakers.
7. System grounding.

C. Certified Test Reports:
1. Field testing shall be performed by a NETA certified, independent third-party testing agency: Apparatus Unlimited, Electro-Test, Power Systems Testing, or approved equal.
2. Verify that the installation is in accordance with the manufacturer's instructions.
3. Verify that the equipment has been fully tested and is operational.
4. Perform testing and compile detailed test reports for each switchboard and overcurrent protection device.

1.6 SHORT CIRCUIT AND COORDINATION STUDY

A. Prepare a short circuit and coordination study based on the actual overcurrent protection devices proposed for use and the actual conductor sizes and lengths. The study shall be prepared by an electrical engineer licensed in the State of **Utah** and shall be submitted as a supplemental permit submission to the Authority Having Jurisdiction.

B. The study shall be submitted with the distribution equipment submittal and shall indicate where device substitutions are being made in order to achieve adequate interrupting capacity ratings for each piece of equipment.

C. The study shall include recommended settings of adjustable overcurrent and ground fault settings.

D. Provide overcurrent protective devices of suitable type and rating to meet or exceed the available short circuit currents indicated in the short circuit study. Circuit breakers and fuses serving the emergency power system as well as circuit breakers protecting elevators, including all upstream feeder circuit breakers, shall be of the appropriate frame size to ensure 100 percent selectivity in the instantaneous region of the trip curves at the calculated fault current. Coordination study shall demonstrate selective coordination is achieved and shall include the effects of ground fault protection devices indicated on the Drawings.

E. Interrupting capacities shall be based on a fully rated protection system where all overcurrent protection devices are rated for the full prospective short circuit current (as indicated in the final short circuit submittal). Series-rated panelboards are not permitted.

F. Obtain from the utility company (and confirm in writing) the short circuit current available at the utility company's transformer secondary.

1.7 ARC FLASH STUDY

A. Prepare an arc flash study for electrical service and distribution equipment. The study shall be prepared by an electrical engineer licensed in the State of **Utah**. Include in the arc flash study the

electrical engineer's name and license number.

B. The study shall be submitted with the electrical service and distribution equipment submittal and shall indicate the required level of protective wear for each piece of electrical equipment.

PART 2 - **PRODUCTS**

2.1 ACCEPTABLE MANUFACTURERS

A. Cutler Hammer, Siemens, or Square D.

2.2 RATINGS

A. Switchboards shall be of the ratings and configurations shown on the Drawings.
   1. Switchboards and overcurrent protection devices shall have a minimum short circuit rating as specified herein or greater where indicated on the Drawings.
   2. Main Switchboards:
   3. Main switchboards are identified with the designation MS as shown on the Drawings.
   4. Maximum allowable physical dimensions: 48 inches wide by 60 inches deep per section.
   5. Main switchboards – circuit breaker type: 100,000 RMS symmetrical amperes minimum interrupting capacity.
   6. Main switchboards – switch and fuse type: 200,000 RMS symmetrical amperes minimum interrupting capacity.

B. Distribution Switchboards:
   1. Distribution switchboards are identified with the designation DSL (120/208V or 208V) or DSH (277/480V or 480V) as shown on the Drawings.
   2. Maximum allowable physical dimensions: 36 inches wide by 24 inches deep per section.
   3. Distribution switchboards (DSL): 42,000 RMS symmetrical amperes minimum interrupting capacity.
   4. Distribution switchboards – circuit breaker type (DSH): 100,000 RMS symmetrical amperes minimum interrupting capacity.
   5. Distribution switchboards – switch and fuse type (DSH): 200,000 RMS symmetrical amperes minimum interrupting capacity.

2.3 CONSTRUCTION

A. Main switchboards shall be front accessible, with group-mounted main and feeder overcurrent protection devices of the number, rating, and arrangement as shown on the Drawings. Vertical sections shall be rear aligned.

A. Where switchboard is utilized for utility service termination, and is located below ground level, provide a separate service-termination pull section incorporating all utility requirements for drip protection.

B. Pull section shall be configured as front-entry.

C. Section size shall meet all current utility requirements at a minimum; confirm current criteria with utility prior to submitting shop drawings.
   1. Provide (1) cable hanger for each conductors, mounted at the top of the pull section, with provisions to tie the cable to the hanger. Arrange service entrance point to provide minimum 6" rise for all conductors upon entering section. Provide cable terminating facilities within pull section, below service entrance point. Arrange service entrance point to provide minimum vertical separation from cable terminating facilities, as specified by utility. Confirm current requirements for minimum separation with utility.

D. Provide additional barriers, moisture barriers, sections, and cable terminating facilities as required

by utility.

E. Distribution switchboards shall be front accessible, with group-mounted main and feeder overcurrent protection devices of the number, rating, and arrangement as shown on the Drawings.

F. Switchboards shall be completely self-supporting structures of the required number of vertical sections bolted together to form a single metal-enclosed switchboard. Sides, top and rear covers shall be code gauge steel, bolted to the switchboard structure. The frame structure members shall be die-formed, 12 gauge steel bolted together and reinforced at corners with rugged gussets internal and external to the switchboard members.

G. Switchboards shall be provided with adequate lifting means, and be capable of being rolled or moved into position and bolted directly to the floor without the use of floor sills.

H. Steel surfaces shall be chemically cleaned and treated, providing a bond between paint and metal surfaces to prevent the entrance of moisture and formation of rust under the paint finish. Finish shall be ANSI 61 gray enamel paint.

I. Space for future devices shall include all necessary bus, overcurrent protection device supports and mounting, and connections.

J. Switchboard enclosures shall be NEMA Type 1 where installed indoors. Switchboard enclosures shall be NEMA Type 3R where installed outdoors. Switchboard sections shall be aligned on top, 90 inches high, unless lower height is required due to space limitations.

K. Where required for conduit terminations, provide pull box on top of switchboard of same type of construction and finish as the switchboard.

L. Where draw-out type overcurrent protection devices are provided, provide a traveling type lifter, rail-mounted on top of the switchboard.

M. For any emergency switchboards served by a generator, the switchboard sections shall be constructed such that overcurrent protective devices serving Emergency System loads (NEC Article 700) are provided with a dedicated vertical distribution section and physically separated within the switchboard lineup from the Legally Required and Optional Standby feeder distribution sections.

N. Flash Protection:
   1. Equipment manufacturer shall provide arc flash warning labels directly on the equipment.
   2. Based on the results from the arc flash study, the required level of protective gear shall be clearly displayed on the warning labels.

2.4 BUS SYSTEM

A. Bus bars shall be arranged throughout A-B-C left to right, top to bottom, and front to rear. Bus joints shall be bolted with high-tensile zinc-plated steel bolts with spring-loaded Bellville type washers.

B. Bus bars shall be plated copper based on ANSI standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure). In addition to full UL air clearances, bus shall be insulated with a minimum of 5-mil thickness of epoxy resin coating. Provide removable non-PVC boots for access to the cross bus joints for inspection and maintenance.

C. Bus bars shall be of the ampere rating (continuous) shown on the Drawings. Neutral bus shall be full size. Provide a 33 percent minimum copper ground bus, extending along the full length of the switchboard.

D. Horizontal bus shall be full size, tapered bus is not permitted. Provide bolt holes drilled and tapped for future extension at the end of bus bars including neutral and ground bus so that the addition of a future section would require only the installation of standard bolted splice plates.

2.5 OVERCURRENT PROTECTION DEVICES

A. General:
   1. Feeder overcurrent protection devices shall be bus-connected on the line side.
   2. Overcurrent protection devices shall have an external operating handle located on the front door.
   3. Stationary or draw-out type construction as shown on the Drawings.

B. Overcurrent protection device types:
   1. Distribution Switchboards (DSL): Molded case circuit breakers.
   2. Distribution Switchboards (DSH): Fusible switch units or molded case circuit breakers as shown on the Drawings.

C. High-Pressure Contact Switches:
   1. Stored energy, quick-make/quick-break operation. Extra heavy duty, low torque, rotary operated handle closing mechanism. Fingertip OPEN button shall instantly open the main contacts.
   2. High interrupting capacity disconnect with electric trip for remote tripping or ground fault protection.
   3. Fuse compartment interlocked to prevent access when switch is closed.
   4. Handle shall be capable of being padlocked in the OFF position.
   5. Positive ON/OFF indicators, green for OFF, red for ON.
   6. UL Class L fuses.
   7. UL Listed for continuous operation at 100 percent rated load.
   8. Blown fuse protection shall trip switch when switch is closed with a blown fuse or no fuse is installed.
   9. Auxiliary switch for remote indication of switch ON/OFF position.
   10. Provide ground fault protection for main and feeder devices as follows:
      a. Current Monitor: The current monitor shall consist of a zero-sequence current transformer which shall enclose all current-carrying conductors, including the neutral conductor if used, of the circuit being protected.
      b. Ground Fault Sensor: The ground fault sensor shall continuously sense the output of the current monitor. Should the sensor detect a ground current in excess of the pick-up setting for a duration exceeding the time delay, the sensor shall shunt-trip the appropriate device.
      c. Test Panels: Each ground fault sensor shall be provided with a test panel which shall completely test the ground fault system. The test panel shall indicate that a ground fault was sensed or test the system with or without tripping the switch. The test panel shall be installed in the front of the switchboard adjacent to the device being protected.
      d. Shunt Trip: Automatically open the device when signaled by the sensor.
      e. Provide fuse-protected control power transformer from the switchboard line side for the ground fault system. Ground fault and shunt-trip device shall be capable of operation at 55 percent of rated voltage.
      f. Set each ground fault sensor pick-up setting at 25 percent of the rating of overcurrent protection device with a 6-cycle time delay or as specifically indicated in the final short circuit and coordination study submittal.

D. Insulated Case Circuit Breakers:
   1. Stored energy charging mechanism and independent close and trip functions.
   2. High interrupting capacity disconnect with electric trip for remote tripping or ground fault protection.
   3. Breaker compartment interlocked to prevent access when breaker is closed.
   4. Handle shall be capable of being padlocked in the OFF position.
   5. Positive ON/OFF indicators, green for OFF, red for ON.
   6. Provide integral residual-sensing ground fault protection for main and feeder devices. Set

each ground fault sensor pick-up setting at 25 percent of the rating of overcurrent protection device with a 6-cycle time delay or as specifically indicated in the final short circuit and coordination study submittal.

7. UL Listed for continuous operation at 100 percent rated load.
8. Auxiliary switches for remote indication of breaker ON/OFF status.
9. Microelectronic digital processor based true RMS trip unit with interchangeable ratings plugs to change the continuous current rating. Provide a hand held, portable plug-in test kit for testing and verifying programmer settings. Provide the following functions:
   a. Current setting adjustment (long delay pick-up)
   b. Long-time delay adjustment
   c. Short-time pick-up adjustment
   d. Short-time delay adjustment
   e. Instantaneous pick-up adjustment
   f. I^2t-In-Out-adjustment
   g. Ground-fault pick-up adjustment
   h. Ground-fault delay adjustment

E. Fusible Switch Units:
   1. Quick-make, quick-break, dead-front type. Each switch shall be a self-contained unit, externally operated from the front.
   2. Fuse and switch compartment with defeatable interlock to prevent access with switch in the ON position.
   3. Switches shall be equipped with rejection type clips suitable for UL Class R fuses up to 600A, suitable for UL Class L fuses above 600A.
   4. Handle shall be capable of being padlocked in the OFF position.

F. Molded case circuit breakers:
   1. Completely sealed enclosure. Toggle type operating handle. Trip ampere rating and ON/OFF indication clearly visible.
   2. Thermal-magnetic trip-free, trip-indicating, quick-make, quick-break, with inverse time characteristic. Single-handle and common tripping on multi-pole breakers. External handle shall be suitable for locking in the OFF position.
   3. Silver alloy contacts with auxiliary arc-quenching devices.
   4. Provide main breakers in switchboards served from transformers.
   5. Shunt-trip breakers shall be supplied with 120V AC coils.

2.6 GROUND FAULT PROTECTION

A. Ground fault protection shall be provided where specified and on service disconnect switches rated 1,000 amperes or more as required by the NEC.

B. Settings: Set each ground fault sensor pick-up setting at 25 percent of the rating of overcurrent device with a 6-cycle time delay unless specifically indicated otherwise in the final short circuit and coordination study submittal.

2.7 UTILITY METERING

A. Provide utility metering cubicle(s) in accordance with the requirements of the serving utility company.

2.8 METERING DISPLAY

A. Provide an electronic digital true RMS-sensing metering display for each main switchboard main and each feeder. The display shall indicate voltage (each phase to each phase, and each phase to neutral), amps (each phase), watts, vars, power factor, frequency, watt demand, and watt hours. Display shall be positioned not lower than 48 inches or higher than 72 inches above the finished

floor.

PART 3 - **EXECUTION**

3.1 GENERAL

A. Install switchboards when the area is free and clear of dust and debris. Protect switchboards from dust and moisture. Do not utilize switchboard for temporary lighting and power services.

B. Install switchboards on 4-inch high concrete housekeeping pads which shall follow the contour of switchboards with 1 inch of overlap on all sides.

C. Provide channel iron sills below each switchboard where the switchboard frame is not suitable for use as a floor sill.

D. Provide 2” empty conduit with pullstring from each utility meter section or panel location terminated horizontally at the exterior of the building eight to ten feet above grade on the outside surface of the building terminated in a 6”x6”x6” NEMA 3R enclosure with an accessible front cover.

E. Provide ½” empty conduit with pullstring from each utility metering section or panel to the nearest telecommunications service location for utility company use. Temporarily cap all terminations.

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