

SECTION 26 24 13

~~~ PROJECT NOTE ~~~~~

ARCHITECT OF RECORD/ENGINEER OF RECORD IS RESPONSIBLE FOR REVIEWING THIS SPECIFICATION SECTION IN DETAIL FOR COORDINATION WITH THE PROJECT SCOPE OF WORK.

ALL "PROJECT NOTE" TEXT IS TO BE REMOVED FOLLOWING REVIEW OF THE CONTENT OF EACH NOTE BY THE ARCHITECT OF RECORD/ENGINEER OF RECORD.

EDIT THE DOCUMENT FOOTER TO INCLUDE THE PROJECT NAME AND NUMBER.

EDIT THE DOCUMENT HEADER TO INDICATE THE ARCHITECT OF RECORD PROJECT ISSUE" DATE. THE "CPS CONTROL" DATE SHOULD NOT BE EDITED.

ANY MODIFICATIONS TO THE TECHNICAL STANDARDS IN THIS SECTION - INCLUDING THE REMOVAL OR ADDITION OF MANUFACTURERS - MUST BE APPROVED BY CPS.

REQUESTS FOR MODIFICATION ARE TO BE SUBMITTED TO THE DESIGN MANAGER DURING THE DESIGN PHASE FOR REVIEW AND APPROVAL.

~~~ END OF PROJECT NOTE ~~~~~

SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.
- B. Overcurrent protective devices for switchboards.

1.02 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Revision E with Supplement 1, 2013.
- B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- G. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.
- H. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less; 2013.
- I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- J. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- K. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- L. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- M. UL 891 - Switchboards; Current Edition, Including All Revisions.
- N. UL 977 - Fused Power-Circuit Devices; Current Edition, Including All Revisions.

- O. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by the City of Chicago Electrical Code.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
5. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Board or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - a. Notify Board no fewer than seven (7) days in advance of proposed interruption of electric service.
 - b. Indicate method of providing temporary electric service if interruption will last longer than eight (8) hours.
 - c. Do not proceed with interruption of electric service without Board's written permission
6. Installation Pathway: Remove and replace access, fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
7. Notify Architect/Engineer of Record of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Preinstallation Meetings:

1. Preinstallation Meeting: Conduct a preinstallation meeting at least one week prior to the start of the work of this section; require attendance by all affected installers.
2. Ensure required submittals have been provided with sufficient time for review prior to scheduling the preinstallation meeting.
3. Review the detailed requirements for the work of this section and to review the drawings and specifications for this work. Require attendance by all affected installers including but not limited to:
 - a. Contractor's Superintendent.
 - b. Installer.
 - c. Manufacturer/Fabricator Representative.
 - d. Utility Company representative.
 - e. Other affected Subcontractors.
 - f. Architect/Engineer of Record.
 - g. Board's Representative.
4. Record minutes and distribute copies within five (5) days after meeting to participants as well as Architect/Engineer of Record, Board and those affected by decisions made.

C. Service Entrance Switchboards:

1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
2. Coordinate with Board to arrange for Utility Company required access to equipment for installation and maintenance.
3. Obtain Utility Company approval of switchboard prior to fabrication.
4. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.
 - 1. Include characteristic trip curves for each type and rating of overcurrent protective device.
- C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.
 - 2. Include wiring diagrams showing all factory and field connections.
 - 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 - 4. Include documentation of listed series ratings upon request.
 - 5. Include documentation demonstrating selective coordination.
- D. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.
- E. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 2 as production (routine) tests.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Field Quality Control Test Reports.
- H. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.
- I. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- J. Maintenance Materials: Furnish the following for Board's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Enclosure Keys: Two (2) of each different key.
 - 3. Electronic Trip Circuit Breakers: Provide one (1) portable test set.
 - 4. Indicating Lights: Equal to 10 percent of amount installed for each size and type, but no fewer than one (1) of each size and type.
 - 5. Potential Transformer Fuses: Equal to 10 percent of amount installed for each size and type, but no fewer than two (2) of each size and type.
 - 6. Control-Power Fuses: Equal to 10 percent of amount installed for each size and type, but no fewer than two (2) of each size and type.
- K. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of the City of Chicago Electrical Code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
 - 1. Obtain switchboards through one source from a single manufacturer.
- D. Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent equipment and surfaces. Comply with indicated maximum dimensions.

- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the Chicago Electrical Code, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with NEMA PB 2, "Deadfront Distribution Switchboards".

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.
- B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.
- C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.07 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Board or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Board no fewer than seven (7) days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service in interruption will last longer than eight (8) hours.
 - 3. Do not proceed with interruption of electric service without Board's written permission.

1.08 WARRANTY

- A. Each piece of equipment shall be warranted by the equipment manufacturer to be free of defects in material and workmanship for a period of twelve (12) months from the date of Preliminary Acceptance. The equipment supplier shall provide a full year of warranty on the entire system, including on-the-premises maintenance service during normal working hours at no cost to Board for parts or labor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Switchboards - Other Acceptable Manufacturers:
 - 1. ABB/GE: www.geindustrial.com/#sle.
 - 2. Eaton Corporation: www.eaton.com.
 - 3. Schneider Electric; Square D Products: www.schneider-electric.us
 - 4. Siemens Industry, Inc: www.usa.siemens.com
 - 5. Chicago Switchboard Company; www.chiswbd.com.
 - 6. Gus Berthold Electric Company; www.berthold.com
- B. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.
- C. Source Limitations: Furnish switchboards and associated components produced by a single manufacturer and obtained from a single supplier.

~~~ PROJECT NOTE ~~~
SELECT SWITCHBOARD CONSTRUCTION TO BE UTILIZED IN CONSTRUCTION. COORDINATE WITH SWITCHBOARD MANUFACTURER'S SIZES AND DIMENSIONS.
~~~ END OF PROJECT NOTE ~~~

2.02 SWITCHBOARDS

- A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.
- D. Hinged Front Panels: Allow access to circuit breakers, metering, accessory, and blank compartments.
- E. Front-Connected Switchboards:
 - 1. Main Device(s): Fixed, individually-mounted..
 - 2. Feeder Devices: Panel/group-mounted.
 - 3. Arrangement: Front accessible only (not rear accessible), front and rear aligned..
 - 4. Gutter Access: Bolted covers.
- F. Rear-Connected Switchboards:
 - 1. Main Device(s): Individually-mounted.
 - 2. Feeder Devices: Individually-mounted.
 - 3. Compartmentalization: Provide barriered compartments for each overcurrent protective device, distribution bus, and rear cable connection area.
 - 4. Arrangement: Rear accessible, front and rear aligned.
 - 5. Rear Access: Bolted covers.
 - 6. Removable, Hinged Rear Doors and Compartment Covers: Secured by captive thumb screws for access to rear interior of switchboard.
- G. Service Entrance Switchboards:
 - 1. Listed and labeled as suitable for use as service equipment according to UL 869A.
 - 2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
 - 3. Comply with Utility Company requirements for electrical service.
 - a. Utility Metering Compartment: Fabricated compartment and section complying with utility company's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard.
 - 4. Utility Metering Provisions: Provide separate barriered compartment complying with Utility Company requirements where indicated or where required by Utility Company. Include hinged sealable door and provisions for Utility Company current transformers (CTs), potential transformers (PTs), or potential taps as required.
 - 5. See Section 26 21 00 - Low-Voltage Electrical Service Entrance for additional requirements.
- H. Nominal System Voltage: Indicated on Drawings.
- I. Main-Bus Continuous Amperage: Indicated on Drawings.
- J. Service Conditions:
 - 1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
 - a. Altitude: Less than 6,600 feet.
 - b. Ambient Temperature:
 - 1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F and 104 degrees F.
 - 2) Switchboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.
- K. Short Circuit Current Rating, Fully Rated:

1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73 - Power System Studies.
- L. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- M. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.
- N. Bussing: Sized in accordance with UL 891 temperature rise requirements.
 1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
 2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 3. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 4. Phase and Neutral Bus Material: Hand-drawn copper of 98 percent conductivity with feeder circuit-breaker line connections.
 5. Ground Bus Material: 1/4-by-2-inch minimum-size, hard-drawn copper. of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 6. Contact Surface of Buses: Silver-plated.
 7. Load Terminals: Insulated, rigidly braced, silver-plated, copper runback bus extensions equipped with pressure connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full ampere rating of circuit-breaker position.
 8. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 9. Neutral Buses: 100 percent of the ampacity of phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus shall be braced.
- O. Conductor Terminations: Suitable for use with the conductors to be installed.
 1. Line Conductor Terminations:
 - a. Main and Neutral Lug Material: Hard-drawn copper of 98 percent conductivity, suitable for terminating copper conductors only..
 - 1) Plating: Silver-Plated.
 - b. Main and Neutral Lug Type: Mechanical.
 2. Load Conductor Terminations:
 - a. Lug Material: Copper, suitable for terminating copper conductors only.
 - 1) Plating: Silver-plated.
 - b. Lug Type:
 - 1) Provide mechanical lugs unless otherwise indicated.
- P. Enclosures:

~~~ PROJECT NOTE ~~~~~
SELECT INDOOR OR OUTDOOR ENCLOSURE FOR ENVIRONMENT TYPE. OUTDOOR ENCLOSURE RARELY USED. VERIFY LOCATION IN PROJECT. IF OUTDOOR ENCLOSURES ARE UTILIZED, PROVIDE ENCLOSURE CHARACTERISTICS.

~~~ END OF PROJECT NOTE ~~~~~

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 2 (drip-proof).

2. Finish: Manufacturer's standard unless otherwise indicated.
3. Enclosure Space Heaters:
 - a. Provide in each switchboard section installed outdoors and in unconditioned indoor spaces.
 - b. Size according to manufacturer's recommendations for worst case ambient temperature to prevent condensation.
 - c. Heater Control: Thermostat.
 - d. Heater Power Source: Provide connection to transformer factory-installed in switchboard or suitable external branch circuit as indicated or as required.
- Q. Comply with NFPA 70E for arc flash labels.
- R. Future Provisions:
 1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
 2. Equip distribution sections with full height vertical bussing to accommodate maximum utilization of space for devices.
 3. Where designated spaces for future device provisions are not indicated, include provisions for minimum of 4 device(s) rated at 10 percent of rating of switchboard main or incoming feed.
 4. Arrange and equip through bus and ground bus to accommodate future installation of additional switchboard sections.
- S. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 43 00 - Surge Protective Devices, list switchboards as a complete assembly including surge protective device.
- T. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 1. Where overcurrent protective devices equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Use zero sequence or residual ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
 - c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.
- U. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.
- V. Board Metering:
 1. Provide microprocessor-based digital electrical metering system including all instrument transformers, wiring, and connections necessary for measurements specified.
 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
 3. Measured Parameters:
 - a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
 - b. Current (Amps): For each phase and neutral.
 - c. Frequency (Hz).
 - d. Real power (kW): For each phase, 3-phase total.
 - e. Reactive power (kVAR): For each phase, 3-phase total.
 - f. Apparent power (kVA): For each phase, 3-phase total.
 - g. Power factor.
 - h. Real energy (kWh).

- i. Reactive energy (kVARh).
- j. Apparent energy (kVAh).
- k. Current demand.
- l. Power demand: Real, reactive, and apparent.
- 4. Meter Accuracy: Plus/minus 1.0 percent.
- 5. Features:
 - a. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.
 - b. KYZ pulse output.
 - c. Adjustable demand interval.
 - d. Remote monitoring capability via PC.
- W. Instrument Transformers:
 - 1. Comply with IEEE C57.13.
 - 2. Select suitable ratio, burden, and accuracy as required for connected devices.
 - 3. Current Transformers:
 - a. Connect secondary to shorting terminal blocks.
 - b. Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
 - 4. Potential Transformers:
 - a. Include primary and secondary fuses with disconnecting means.
 - b. Secondary voltage rating of 120V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
 - 5. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3kV.

~~~ PROJECT NOTE ~~~
SELECT OVERCURRENT PROTECTIVE DEVICES TO BE UTILIZED ON PROJECT. SPARE FUSES AND FUSE STORAGE CABINETS TO BE MODIFIED IN SPECIFICATION SECTION "26 28 13 FUSES".

~~~ END OF PROJECT NOTE ~~~

2.03 OVERCURRENT PROTECTIVE DEVICES

- A. General:
 - 1. Provide with provisions for locking in the open/off position with a maximum of three (3) padlocks.
 - 2. Provide key interlocking according to the scheme described and shown on the drawings.
 - 3. Ground fault protection shall be provided for solidly grounded wye connected services over 150 volts to ground for all main and feeder devices rated 1000 amperes and as indicated on the drawings.
- B. Fusible Devices:
 - 1. Fusible Switches:
 - a. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, Type HD, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
 - b. Fuse Clips: As required to accept indicated fuses.
 - 1) Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
 - c. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
 - 2. Fused Power-Circuit Devices:

- a. Description: Quick-make, quick-break, dead-front bolted-pressure contact switches and high-pressure butt contact switches listed and labeled as complying with UL 977; ratings, configurations, and features as indicated on the drawings.
 - b. Bolted-Pressure Contact Switches: Devices with additional pressure or clamping action provided at both ends of switch blades when blades are in the fully closed position.
 - c. High-Pressure Butt Contact Switches: Devices with butt-type contacts and spring-charged mechanism.
 - d. Minimum Short Circuit Current Rating: 200,000 rms symmetrical amperes when protected by Class L fuses.
 - e. Fuse Clips: As required to accept Class L fuses.
 - f. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
 - g. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - 2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating switch position.
 - 3) Blown fuse protection and indication.
- C. Circuit Breakers:
1. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 2. Molded Case Circuit Breakers:
 - a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. NEMA AB 3 with Minimum Interrupting Capacity: Fully rated.
 - d. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - 1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 250 amperes and larger.
 - 2) Provide interchangeable trip units where indicated.
 - e. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - f. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - 1) Provide the following field-adjustable trip response settings:
 - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - (b) Long time delay.
 - (c) Short time pickup and delay.
 - (d) Instantaneous pickup.
 - (e) Ground fault pickup and delay where ground fault protection is indicated.
 - 2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground

- fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
- 3) Provide communication capability where indicated: Compatible with system indicated.
- g. Provide the following circuit breaker types where indicated:
 - 1) 100 Percent Rated Circuit Breakers: Listed for application within the switchboard where installed at 100 percent of the continuous current rating.
 - 2) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
 - h. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - 2) Pad-Lock Provision: For locking circuit breaker handle in OFF position.
 - 3) Auxiliary Switch: Two SPDT switches suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
 - (a) With "a" and "b" contacts, "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - 4) Undervoltage Release: Set to operate at 35 to 75 percent of rated voltage with field-adjustable time delay to prevent nuisance tripping.
 - 5) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.
 - i. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
 - 1) Integrally mounted relay and trip with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - j. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - k. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Insulated Case Circuit Breakers:
- a. Description: Quick-make, quick-break, trip-free circuit breakers with two-step stored energy closing mechanism; standard 80 percent rated unless otherwise indicated; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
 - b. Operation:
 - 1) Provide manually operated circuit breakers unless otherwise indicated.
 - 2) Provide electrically operated circuit breakers where indicated.
 - 3) Pad-Lock Provision: For preventing circuit breaker closing operation. Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - c. Construction:
 - 1) Provide fixed-mount circuit breakers unless otherwise indicated.
 - d. Minimum Interrupting Capacity: Fully rated.
 - e. Trip Units: Solid state, microprocessor-based, true rms sensing with LED trip indicators.
 - 1) Provide the following field-adjustable trip response settings:
 - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - (b) Long time delay.
 - (c) Short time pickup and delay.
 - (d) Instantaneous pickup.
 - (e) Ground fault pickup and delay where ground fault protection is indicated. Solid-state type, field wiring terminals and interface devices to accommodate zone selective control, adjustable pickup current from 100 to

- 1200 amperes, field-adjustable time delay from instantaneous to 1 second, UL 1053, Class II, monitor panel with ground fault indicators, control power indicators, TEST and RESET buttons.
- 2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
 - 3) Provide communication capability where indicated: Compatible with system indicated.
- f. Provide the following circuit breaker types where indicated:
- 1) 100 Percent Rated Circuit Breakers: Listed for application within the switchboard where installed at 100 percent of the continuous current rating.
 - 2) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
- g. Provide the following features and accessories where indicated or where required to complete installation:
- 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - 2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
 - 3) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
 - 4) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.
 - 5) Truck-Operated Cell Switch: For indicating circuit breaker racking position.

2.04 CONTROL POWER

- A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.

~~~ PROJECT NOTE ~~~~~
VERIFY IF "ELECTRICALLY INTERLOCKED MAIN AND TIE" CIRCUIT BREAKERS IS REQUIRED FOR PROJECT.

~~~ END OF PROJECT NOTE ~~~~~

- B. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
- C. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- D. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.05 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
1. Dielectric tests.
 2. Mechanical operation tests.
 3. Grounding of instrument transformer cases test.

4. Electrical operation and control wiring tests, including polarity and sequence tests.
5. Ground-fault sensing equipment test.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive switchboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.
- C. Arrange equipment to provide required clearances and maintenance access.
- D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch between switchboard and wall.
- E. Provide required support and attachment components in accordance with Section 26 05 29 - Hangers and Supports for Electrical Systems.
- F. Install switchboards plumb and level.
- G. Unless otherwise indicated, mount switchboards on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.
- H. Provide grounding and bonding in accordance with Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- I. Install all field-installed devices, components, and accessories.
- J. Provide fuses complying with Section 26 28 13 - Fuses for fusible switches as indicated.
- K. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- L. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed in accordance with Section 26 05 73 - Power System Studies.
- M. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- N. Provide filler plates to cover unused spaces in switchboards.
- O. Identify switchboards in accordance with Section 26 05 53 - Identification for Electrical Systems.
- P. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- Q. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.
- C. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

- D. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.
- E. Inspect and test in accordance with NETA ATS, except Section 4.
- F. Perform inspections and tests listed in NETA ATS, Section 7.1.
- G. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- H. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers. Tests listed as optional are not required.
- I. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by the City of Chicago Electrical Code.
 - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
- J. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
- K. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- L. Test shunt trips to verify proper operation.
- M. Correct deficiencies and replace damaged or defective switchboards or associated components.
- N. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of switchboard covers and doors.

3.05 CLEANING

- A. See Section 01 74 19 - LEED Construction Waste Management and Disposal, for additional requirements.
- B. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.
- C. Repair scratched or marred surfaces to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Training: Train Board's personnel on operation, adjustment, and maintenance of switchboard and associated devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of four (4) hours of training.
 - 3. Instructor: Manufacturer's authorized representative.
 - 4. Location: At project site.

3.07 PROTECTION

- A. Protect installed switchboards from subsequent construction operations.

END OF SECTION 26 24 13