

26 24 13 SWITCHBOARDS: SIGNIFICANT (OR TOTAL) DELETION OF EXISTING TEXT

Delete the following current section in its entirety (deletions are shown struck through).

~~.01 General~~

- ~~A. Refer to Service Entrance Equipment in 26 20 00 for additional requirements.~~
- ~~B. Provide hinged doors, front and, as applicable, rear. Rear doors shall have hasp for padlock. Label rear doors to match the front.~~
- ~~C. Provide vertical barrier between adjacent upright sections to prevent arc event from traveling through the rear of the lineup.~~
- ~~D. Provide at least one (1) spare breaker in each frame size and at least 10% fully provisioned space capacity.~~

Replace with following text.

.01 General

- A. Refer to Service Entrance Equipment in 26 20 00 for additional requirements.
- B. Provide at least one (1) spare breaker in each frame size and at least 10% fully provisioned space capacity.

.02 Guide Specifications

- A. Design Professional shall carefully review and edit the guideline specifications below, adapting them as needed to achieve application-specific, fully developed specifications for each project.
- B. These shall be edited using the process described in the instructions contained at the beginning of the document. Proposed modifications shall be reviewed with OPP Engineering Services.
- C. Finalized version shall be included in the project contract documents. Use of other specifications is not acceptable.

<u>Document</u>	<u>Version Date</u>	<u>Description</u>
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<u>Document</u>	<u>Version Date</u>	<u>Description</u>
<u>Switchboard Guide Specification.docx</u>	<u>June 2016</u>	<u>University's guide specification for Switchboards; to be used by the design professional.</u>
<u>Switchboard Datasheet (PDF)</u>	<u>June 2016</u>	<u>Typical University Transformer Datasheet for the Professionals use. The datasheet instructions are found in the guide specification and a sample is found in Division 26 00 00.</u>

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

- 1) Deleted old section and replaced with new section, which includes a new guide specification section and new additional datasheet.

SECTION 262413 - SWITCHBOARDS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the term "Architect." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

General Notes:

1. *This guide specification is intended to provide the Design Professional with a basic guideline of minimum OPP requirements.*
2. *The guide specification shall be carefully reviewed and edited with respect to application-specific project requirements. Proposed modifications shall be reviewed with OPP Staff.*
3. *Finalized version shall be included in the project contract documents.*

Editing Notes

1. *This OPP Guide specification must only be altered by notation (i.e. deleted text with strikethrough and additional text with double underline). This shall be accomplished by using Tools /Track Changes / Highlight Changes, and select "Track changes while editing" in MS Word or equivalent.*
2. *The Review Submittal Specification section shall be provided in electronic form for OPP Review.*
3. *Leave the following Note ("For Construction Document Review, Design Submittal") as part of the Review Submittal, to aid any Reviewer to understand WHY there are strikeouts and underlines. Also, leave any "DESIGNER NOTE" placed in this Guide Spec.*
4. *AFTER comments are received from PSU and incorporated, the strikeouts and underlines shall be removed, and the REVIEWER NOTEs deleted, before the spec is issued for Bidding.*
5. *Data Sheet Instructions:*
 - a. *Engineer completes "SPEC DATA" column with information about equipment including but not limited to ratings, features and options. The data sheet is then submitted with completed specifications for bid.*
 - b. *Manufacturer completes "VENDOR DATA" column and returns completed data sheet with bid or submittal.*
 - c. *Engineer verifies that design specifications have been met by checking that specified features match submitted features.*

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of the project manual are directly applicable to this specification section. Should a conflict arise between specification sections or between specifications and drawings and/or code requirements, the contractor shall notify the Architect/Engineer of the conflict in writing. If direction is not provided prior to the submission of the bid, the contractor shall price the more extensive system.

1.2 SUMMARY

- A. Section Includes:
 - 1. Service and distribution switchboards rated 600 V and less.
 - 2. Surge protection devices.
 - 3. Disconnecting and overcurrent protective devices.
 - 4. Instrumentation.
 - 5. Control power.
 - 6. Accessory components and features.
 - 7. Identification.
 - 8. Mimic bus.

Mimic bus is not common for switchboards other than large, drawout-type switchboards; it is normally used for switchgear construction.

1.3 ACTION SUBMITTALS

- A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
 - 1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.

Retain first subparagraph below if optional barriers are specified.

5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.

Retain first subparagraph below if final system short-circuit and coordination studies will be performed by designer or assigned to independent consultant. These curves are also beneficial to Owner for future additions or reevaluations of settings of overcurrent protective devices.

7. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Include selectable ranges for each type of overcurrent protective device.

Retain first subparagraph below if mimic bus is specified.

8. Include diagram and details of proposed mimic bus.
9. Include schematic and wiring diagrams for power, signal, and control wiring.

Retain "Samples" Paragraph below if mimic bus is specified.

1.4 INFORMATIONAL SUBMITTALS

Coordinate "Qualification Data" Paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as may be supplemented in "Quality Assurance" Article. Both NECA 400 and NEMA PB 2.1 recommend that installers be "qualified," which is defined in NFPA 70.

A. Qualification Data: For testing agency.

Retain "Seismic Qualification Certificates" Paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 260548.16 "Seismic Controls for Electrical Systems." See ASCE/SEI 7 for certification requirements for equipment and components.

B. Seismic Qualification Certificates: For switchboards, overcurrent protective devices, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Retain "Field Quality-Control Reports" Paragraph below if Contractor is responsible for field quality-control testing and inspecting.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Routine maintenance requirements for switchboards and all installed components.
 - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Include selectable ranges for each type of overcurrent protective device.

1.6 MAINTENANCE MATERIAL SUBMITTALS

Coordinate this article with Section 262813 "Fuses" for quantities of spare fuses and spare-fuse cabinet to be provided and with choices made in the specification.

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
 - 2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
 - 4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
 - 5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
 - 6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

Retain "Testing Agency Qualifications" Paragraph below if Contractor selects testing agency or if Contractor is required to provide services of a qualified testing agency in "Field Quality Control" Article. Qualification requirements are in addition to those specified in Section 014000 "Quality Requirements," which also defines "NRTL" (nationally recognized testing laboratory).

- B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

Retain first paragraph below if site conditions require supplemental heating to prevent condensation. Select first option if switchboards do not have factory-installed space heaters; select second option if switchboards have factory-installed space heaters specified in Part 2.

- B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.

See "Testing and Inspecting" Article in the Evaluations for guidance on which option to select in paragraph below.

- C. Handle and prepare switchboards for installation according to NECA 400 and NEMA PB 2.1.

1.9 FIELD CONDITIONS

Revise "Installation Pathway" Paragraph below to describe specific requirements for moving switchboards into place. Where appropriate, indicate alterations to existing facilities that may be required to accommodate an indicated delivery path. Coordinate with Drawings.

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

Retain "Environmental Limitations" Paragraph below for switchboards installed in typical environmental conditions. For switchboards installed outdoors or in unusual environmental conditions, revise paragraph to indicate minimum and maximum ambient temperatures and expected humidity range. See "Switchboard Design" Article in the Evaluations.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and[**temporary**] HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding **104 deg F (40 deg C)**.
 - b. Altitude: Not exceeding **6600 feet**.

Retain "Unusual Service Conditions" Paragraph below or revise to accommodate unusual service conditions that cannot be eliminated. See "Switchboard Design" in the Evaluations.

- C. Unusual Service Conditions: NEMA PB 2, as follows:
1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet.

Retain "Interruption of Existing Electric Service" Paragraph below if interruption of existing electric service is required.

- D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify [**Construction Manager**] [**Owner**] no fewer than two weeks in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without [**Construction Manager's**] [**Owner's**] written permission.
 4. Comply with NFPA 70E.

1.10 COORDINATION

Revise first paragraph below for types of construction and encumbrances that affect switchboard installation.

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

When warranties are required, verify with Owner's counsel that warranties stated in this article are not less than remedies available to Owner under prevailing local laws.

- A. **Manufacturer's Warranty:** Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.

Verify available warranties and warranty periods with manufacturers listed in Part 2 articles.

1. **Warranty Period:** Three years from date of Substantial Completion.

- B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.

Verify available warranties and warranty periods with manufacturers listed in Part 2 articles.

1. Warranty Period: **[Five]** <Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

See Editing Instruction No. 1 in the Evaluations for cautions about named manufacturers and products. For an explanation of options and Contractor's product selection procedures, see Section 016000 "Product Requirements."

2.1 PERFORMANCE REQUIREMENTS

Retain "Seismic Performance" Paragraph below with "Seismic Qualification Certificates" Paragraph in "Informational Submittals" Article for projects requiring seismic design. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Verify requirements of authorities having jurisdiction.

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7]** <Insert requirement>.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.

Retain subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

2.2 SWITCHBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. General Electric Company
 2. Eaton Corporation
 3. Square D; by Schneider Electric
 4. Siemens Power Transmission & Distribution, Inc.
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

Retain "Product Selection for Restricted Space" Paragraph below to allow drawing details based on one manufacturer's product to establish requirements and still allow competition. Coordinate with Section 016000 "Product Requirements."

- C. 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.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.
- G. Comply with UL 891.

Switchboards described in this article include service and distribution types most commonly applied.

Coordinate type of switchboard with types of overcurrent protective devices and with switchboard arrangement and available space. Consult manufacturer to determine layout requirements. See the Evaluations for further discussion. Most switchboards are both front and rear aligned, with the exception of units with very large or unusual main cubicles or units with only panel-mounted distribution MCCB. The Section Text defaults to front and rear alignment; coordinate with manufacturers for unusual conditions.

Retain one or more of first three paragraphs below. If retaining more than one, identify switchboard types on Drawings. Note that ICCB, LVPCB, and bolted pressure contact switches are all individually mounted.

- H. Front- and Rear-Accessible Switchboards:
 - 1. Main Devices: Drawout mounted.
 - 2. Branch Devices: Fixed, individually mounted.
 - 3. Sections [**front and rear**] [**rear**] aligned.

Retain "Nominal System Voltage" or "Main-Bus Continuous" Paragraph below if rating data are not on Drawings.

- I. Nominal System Voltage: [**480Y/277 V**] [**208Y/120 V**] <Insert system voltage>.
- J. Main-Bus Continuous: 1600A.

Retain "Seismic Requirements" Paragraph below for projects in seismic areas. If retaining, also retain "Seismic Qualification Certificates" Paragraph in "Informational Submittals" Article.

- K. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.

Retain one of two subparagraphs below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Second definition is used for essential facilities where equipment must operate immediately after an earthquake.

- a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

Switchboards rely on natural convection for dissipating heat; therefore, NEMA 250, Type 12 enclosures are not usually available.

- L. Indoor Enclosures: Steel, NEMA 250, Type 1.

Custom colors, especially for outdoor units, are normally available as an option. Coordinate with Architect or Owner to determine if a special color is required. Consider a white or very light color for the roofs of outdoor units for better reflectance.

- M. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

- N. Outdoor Enclosures: Type 3R.

1. Finish: Factory-applied finish in manufacturer's **[standard]** **[custom]** color; undersurfaces treated with corrosion-resistant undercoating.
2. Enclosure: **[Flat]** **[Downward, rearward sloping]** roof; **[bolt-on rear covers]** **[rear hinged doors]** for each section, with provisions for padlocking.
3. Doors: Personnel door at each end of aisle, minimum width of **[30 inches (762 mm)]** **<Insert value>**; opening outwards; with panic hardware and provisions for **[padlocking]** **[cylinder lock]**. At least one door shall be sized to permit the largest single switchboard section to pass through without disassembling doors, hinges, or switchboard section.
4. Accessories: Fluorescent lighting fixtures, ceiling mounted; wired to a three-way light switch at each end of aisle; ground-fault circuit interrupter (GFCI) duplex receptacle; emergency battery pack lighting fixture installed on wall of aisle midway between personnel doors.
5. Power for Space Heaters, Ventilation, Lighting, and Receptacle: Include a control-power transformer, with spare capacity of 25 percent, within the switchboard. Supply voltage shall be **[120 V]** **[120/240 V]** **[120/208 V]** ac.

- O. Barriers: Between adjacent switchboard sections.

Internal barriers and extra insulation are not an ANSI or a UL requirement, and they can interfere with ventilation required for heat dissipation. Insert internal barriers and extra insulation to isolate energized

components, such as buses and vertical sections, if required to protect against damage from arcing ground faults; coordinate with manufacturers for restrictions, limitations, and bus-size increases. As another option, consider using low-voltage, metal-clad switchgear. See the Evaluations for further discussion.

- P. Insulation and isolation for[**main bus of main section and**] main and vertical buses of feeder sections.

Retain "Space Heaters" Paragraph below for switchboards installed outdoors. Heaters and controls may be required for indoor units in unconditioned spaces.

- Q. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.

Where overcurrent devices are mounted on both sides of a central walk-in corridor, more than one thermostat may be required.

1. Space-Heater Control: [**Thermostats to maintain temperature of each section above expected dew point**] [**Manual switching of branch-circuit protective device**].
 2. Space-Heater Power Source: [**Transformer, factory installed in switchboard**] [**120-V external branch circuit**].
- R. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain a main service disconnect with overcurrent protection. Service entrance equipment rated three phase 4-wire 480VAC, 1000A and larger, shall have second level ground fault protection (i.e. main and feeder breakers shall have ground fault protection). Ground fault protection shall not be used on three phase 4-wire 208VAC systems, unless directed by PSU Engineering Services.

Retain second option in "Customer Metering Compartment" Paragraph below if metering requires a voltage different from switchboard bus voltage.

1. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks. Compartment shall include CT's on a shorting block and voltage connection brought to an insulated (finger safe) fuse block with disconnect (install voltage connection ahead of the main). Shorting blocks shall be located in the front section of the switchgear and in the metering cubicle.
2. PSU Utilities will install service metering. Modify compartment to accept a Square D meter, contact OPP Engineering Services for details.

Pull sections in "Bus Transition and Incoming Pull Sections" Paragraph below are usually required if incoming supply is beneath switchboard. If the main disconnect is equipped for bottom feed, a pull section may not be required.

- S. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

Retain "Removable, Hinged Rear Doors and Compartment Covers" Paragraph below for rear access.

- T. Removable, Hinged Rear Doors and Compartment Covers: Secured by captive thumb screws, for access to rear interior of switchboard. Provide hasp for padlock.
- U. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

A pull box across the entire top of switchboard is usually only required for very large quantities of outgoing feeders and across the main incoming section for very large feeders with multiple large conductors per phase and neutral. Indicate the presence and extent of pull boxes on Drawings.

- V. Pull Box on Top of Switchboard:
 - 1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.

Retain first subparagraph below for top-mounted, circuit-breaker removal mechanism.

- 2. Set back from front to clear circuit-breaker removal mechanism.
 - 3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
 - 4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
 - 5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- W. Buses and Connections: Three phase, four wire unless otherwise indicated.
 - 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.

Retain one of two "Phase- and Neutral-Bus Material" subparagraphs below for main-bus material.

- 2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated.

Retain one of first two subparagraphs below for circuit-breaker line connection material. Copper connections from aluminum bus are not usually available.

- 3. Copper feeder circuit-breaker line connections.

Retain "Load Terminals" Subparagraph below if drawout circuit breakers and rear-access sections are specified.

- 4. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
 - 5. Ground Bus: [~~1/4-by-2-inch- (6-by-50-mm-)~~] [~~1/4-by-1-inch- (6-by-25-mm-)~~] Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.

Tapered bus is available, and may be standard, from some manufacturers. Tapered bus may preclude future expansion of the switchboard or even the rearrangement of loads to accommodate load changes. Full-size bus throughout is recommended but can be modified to obtain a cost saving.

6. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
7. Disconnect Links:
 - a. Isolate neutral bus from incoming neutral conductors.
 - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.

Retain one of two "Neutral Buses" Subparagraphs below or delete both for three-phase, three-wire systems. Neutral buses can be reduced in size if a substantial portion of the loads are balanced three-phase types (e.g., motors and transformers). Neutral buses can be deleted if switchboards serve only three-phase balanced loads. For service-entrance rated switchboards, neutral buses need not extend beyond the switchboard's main incoming section.

8. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with **[mechanical]** **[compression]** connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

Retain "Isolation Barrier Access Provisions" Subparagraph below if optional barriers are specified.

9. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

Retain "Future Devices" Paragraph below to require provisions for future expansion.

- X. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

Insulation on buses retains heat and reduces ampacity, which means larger bus bars are required. Retain "Bus-Bar Insulation" Paragraph below if Project conditions require bus insulation; coordinate with manufacturers for restrictions, limitations, and bus-size increases. Uninsulated buses are standard.

- Y. Bus-Bar Insulation: Factory-applied, flame-retardant of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

"Fungus Proofing" Paragraph below is usually recommended only for installations in humid tropical environments.

2.3 SURGE PROTECTION DEVICES

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

Retain one of two "SPDs" paragraphs below. See "Surge Protection" Article in the Evaluations for discussion of applying Type 1 and Type 2 devices at service entrance locations.

- B. SPDs: Comply with UL 1449, **[Type 1]** **[Type 2]**.

- C. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1.
- D. Features and Accessories:

Retain first subparagraph below when specifying Type 1 SPD to be installed ahead of the service disconnect, when this disconnect is installed to facilitate maintenance.

1. Integral disconnect switch.

Retain first subparagraph below to disconnect the SPD when low-current, high-impedance faults occur.

2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Indicator light display for protection status.

The 5 A and 250-V ac rating of the Form-C contacts is suitable for remote annunciators using Class 1 control circuits. Insert other ratings when monitoring is performed by Ethernet communications protocol used by building power monitoring and control system.

4. Form-C contacts rated at [5 A and 250-V ac] [2 A and 24-V ac] <Insert values>, one normally open and one normally closed, for remote monitoring of protection status.[**Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.**]
5. Surge counter.

See "Surge Protection" Article in the Evaluations for guidance before retaining an option in "Peak Surge Current Rating" Paragraph below. Generally, available surge current ratings are 300, 250, 200, 150, and 100 kA.

- E. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than [200 kA] [250kA] [300 kA] <Insert value>. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

Retain one of first two paragraphs below. Verify compatibility of peak surge current rating and voltage protection rating (VPR).

- F. Protection modes and UL 1449 VPR for grounded wye circuits with [480Y/277 V] [208Y/120 V], three-phase, four-wire circuits shall not exceed the following:
 1. Line to Neutral: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
 2. Line to Ground: [1200 V for 480Y/277 V] [1200 V for 208Y/120 V].
 3. Line to Line: [2000 V for 480Y/277 V] [1000 V for 208Y/120 V].
- G. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
 1. Line to Neutral: 700 V.
 2. Line to Ground: [700 V] [1000 V].
 3. Line to Line: 1000 V.

See "Surge Protection" Article in the Evaluations for discussion on SCCR selection in "SCCR" Paragraph below.

- H. SCCR: Equal or exceed [100 kA] [200 kA] <Insert value>.

See "Surge Protection" Article in the Evaluations for discussion on nominal selection in "Nominal Rating" Paragraph below.

- I. Nominal Rating: 20 kA.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

Coordinate this article with Drawings. See the "Disconnecting and Overcurrent Protective Devices" Article in the Evaluations for guidance on making selections.

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250A and larger.

Adjustable instantaneous-trip circuit breakers: Magnetic trip element with front-mountable, field-adjustable trip setting.
 2. Electronic trip circuit breakers (required on 400A frame and larger):
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Display of settings, and cause of trip targets.
 - d. Integral test jack for connection to portable test set or laptop computer.
 - e. Field-adjustable settings:

Retain one or more of first four subparagraphs below; coordinate required adjustable settings with Section 260573 "Overcurrent Protective Device Coordination Study." See "Electronic rms Trip versus Thermal-Magnetic Circuit Breakers" Paragraph in "Disconnecting and Overcurrent Protective Devices" Article in the Evaluations for additional guidance on specifying full- or standard-function features.

- 1) Instantaneous trip.
- 2) Long- and short-time pickup levels.
- 3) Long and short time adjustments.

Retain below ground-fault pickup level as determined required by designer.

- 4) Ground-fault pickup level, time delay, and I^2t response.
3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.

Retain "GFCI Circuit Breakers" Subparagraph below for GFCI circuit breakers for personnel ground-fault protection as required by NFPA 70; retain "Ground-Fault Equipment Protection (GFEP) Circuit Breakers"

Subparagraph for GFEP circuit breakers (e.g., for self-limiting heat-trace cables) as required by NFPA 70. GFCI and GFEP circuit breakers are only available fully rated up to interrupting ratings of 22 kA and are not suited to switchboard use. For switchboards subject to fault currents above 22 kA, series ratings must be used. Consider relocating these to downstream panelboards more suited to their application.

5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. MCCB Features and Accessories:

Not all accessories and options listed in subparagraphs below are available for every rating and from every listed manufacturer. Verify availability and unique characteristics with manufacturers selected. The accessories listed below are optional and not to be used in every situation, discuss with PSU regarding accessories used.

- a. Standard frame sizes, trip ratings, and number of poles.

See the Evaluations for guidance on using mechanical versus compression lugs.

- b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
- c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

Select first option in "Ground-Fault Protection" Subparagraph below for solid-state trip units; select second option for thermal-magnetic trip units. If selecting second option, also retain "Shunt Trip" Subparagraph below.

- d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 - f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at **[55] [75]** percent of rated voltage.
 - g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - h. Auxiliary Contacts: **[One SPDT switch] [Two SPDT switches]** with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - j. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in **[on] [off] [on or off]** position.
- B. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
1. **[Fixed] [Drawout]** circuit-breaker mounting.
 2. Two-step, stored-energy closing.
 3. Full-function, microprocessor-based trip units:

- a. RMS sensing.
- b. Field-replaceable rating plug or electronic trip.
- c. Digital display of settings, trip targets, and indicated metering displays.
- d. Multi-button keypad to access programmable functions and monitored data.
- e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
- f. Integral test jack for connection to portable test set or laptop computer.
- g. Field-adjustable settings:

Retain one or more of first four subparagraphs below; coordinate required adjustable settings with Section 260573 "Overcurrent Protective Device Coordination Study." See "Electronic rms Trip versus Thermal-Magnetic Circuit Breakers" Paragraph in "Disconnecting and Overcurrent Protective Devices" Article in the Evaluations for additional features available for standard- and full-function trip units.

- 1) Instantaneous trip.
- 2) Time adjustments for long- and short-time pickup.
- 3) Ground-fault pickup level, time delay, and I^2t response.
- 4) <Insert settings>.

4. ICCB Features and Accessories:

Not all accessories and options listed in subparagraphs below are available for every rating and from every listed manufacturer. Verify availability and unique characteristics with manufacturers selected. The accessories listed below are optional and not to be used in every situation, discuss with PSU regarding accessories used.

- a. Standard frame sizes, trip ratings, and number of poles.

See the Evaluations for guidance on using mechanical versus compression lugs.

- b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
- c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

Select first option in "Ground-Fault Protection" Subparagraph below for solid-state trip units; select second option for thermal-magnetic trip units. If selecting second option, also retain "Shunt Trip" Subparagraph below.

- d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
- f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at [55] [75] percent of rated voltage.
- g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
- h. Auxiliary Contacts: [One SPDT switch] [Two SPDT switches] with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

- i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - j. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in [on] [off] [on or off] position.
- C. The trip unit shall utilize ARMs Technology (Arc Flash Reduction Maintenance System), or similar as prior approved by Owner. The ARMs Technology shall be provided in a system that shall reduce the trip unit Instantaneous pickup value when activated. The ARMs device shall not compromise breaker phase protection even when enabled. Once the ARMs unit is disabled, the recalibration of trip unit phase protection shall not be required. Activation and deactivation of the ARMs Technology trip setting shall be accomplished without opening the circuit breaker door and exposing operators to energized parts. The ARMs Technology shall provide a clearing time of 0.04 seconds, adjustable with a minimum of five settings ranging from 2.5X to 10X of the sensor value.
- a. The ARMs Technology shall be enabled via a switch on the trip unit. It shall also provide confirmation of protection via a Blue LED.
 - b. The ARMs Technology shall be provided with remote “enable/disable” control and confirmation of protection via an IR communication link.
 - c. The ARMs Technology shall be provided with a switchgear panel mounted enable pad-lockable selector switch and indication via Blue LED pilot light.
 - d. The ARMs Technology shall be wired locally with interposing relays and wired to terminal blocks to enable a remote selector switch and confirmation light to be mounted a the downstream protected distribution equipment.
 - e. The manufacturer shall provide all necessary hardware and software to program the trip units including arc flash reduction settings. The software provided shall be the full version with a non-expiring license and be updatable to a current version if Owner elects to update the software. There shall be no charge to Owner to update the software.
1. Arc flash light/current sensing system may be used in lieu of ARMS Technology with prior approval from Owner.

Retain "Bolted-Pressure Contact Switch" or "High-Pressure, Butt-Type Contact Switch" Paragraph below.

- D. Fused Switch: KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- E. Fuses are specified in Section 262813 "Fuses."

2.5 INSTRUMENTATION

Retain this article for Owner, not utility, metering.

- A. Instrument Transformers: NEMA EI 21.1, and the following:

Potential transformers (PTs) are not frequently needed, as most digital meters can be direct-bus connected up to 600 V. Consult manufacturers on need for PTs for instruments and meters selected. Indicate the primary-to-secondary ratio on Drawings.

1. Potential Transformers: NEMA EI 21.1; 120 V, 60 Hz, [**single**] [**tapped**] [**double**] secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.

Coordinate "Current Transformers" Subparagraph below with Drawings and indicate specific accuracy classes and burdens required for each application and the primary-to-secondary ratio.

2. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary; [**wound**] [**bushing**] [**bar or window**] type; [**single**] [**double**] secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.

Manufacturers typically size control-power transformers and normally only for equipment and devices integral to switchboards. Consider specifying additional spare capacity if required for operation of remote devices.

3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.

Retain "Current Transformers for Neutral and Ground-Fault Current Sensing" Subparagraph below for certain ground-fault protection situations such as double-ended switchboards on four-wire, grounded neutral systems. Coordinate with Drawings.

4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

Retain "Multifunction Digital-Metering Monitor" Paragraph below if digital metering is required. It offers substantially more capabilities than analog metering in much smaller packages; however, some facility managers still prefer analog devices with large, easy-to-read dials.

Retain one of three "Control Circuits" paragraphs below.

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

Retain three paragraphs below to require an automatic transfer of power using a main-tie-main or two-main scheme. Coordinate with selection of "Control Circuits" paragraphs above. See "Interlocked Main and Tie Circuit Breakers for Automatic and Manual Transfer of Power" Paragraph in "Disconnecting and Overcurrent Protective Devices" Article in the Evaluations for discussion of other types of available transfer schemes, along with advantages and disadvantages of each type.

- C. 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.

- D. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- E. 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.

2.6 ACCESSORY COMPONENTS AND FEATURES

Retain "Accessory Set" Paragraph below for drawout circuit breakers.

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

Retain "Portable Test Set" Paragraph below for circuit breakers with solid-state trip devices.

- B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

Retain "Portable Circuit-Breaker Lifting Device" or "Overhead Circuit-Breaker Lifting Device" Paragraph below or both for installations with drawout circuit breakers. Coordinate requirements in first paragraph with manufacturers. Type of circuit-breaker lifting device to use depends on type and sizes of drawout circuit breakers or switches specified, on depth of switchboard and frontal protrusion of concrete base on which it sits, and on manufacturer.

- C. Overhead Circuit-Breaker Lifting Device for Drawout Breakers: Mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.

Retain "Spare-Fuse Cabinet" Paragraph below if fuse cabinet is not specified in Section 262813 "Fuses."

- D. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in Section 260548.16 "Seismic Controls for Electrical Systems" or manufacturer's instructions.
- E. Provide all accessories needed for primary injection testing of the breaker when removed from its respective cell pertaining to ARMS settings testing.

2.7 IDENTIFICATION

Retain one of three "Mimic Bus" paragraphs below. Traditional mimic buses do not lend themselves to switchboard construction, especially for panel-mounted devices.

- A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic (Gravoply) nameplate.
 1. Nameplate: At least **0.0625-inch-** (1.588 mm-) thick laminated plastic (Gravoply), located at eye level on front cover of the switchboard incoming service section.

- B. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

Revise "Presentation Media" Paragraph below to require other types of presentation media.

Retain "Service Equipment Label" Paragraph below for switchboards that incorporate one or more service disconnecting and overcurrent protective devices and that are used as the service entrance, outside feeder, or separately derived source means of disconnect and overcurrent protection.

- C. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

Referenced NECA and NEMA standards in first paragraph below include similar requirements. See "Testing and Inspecting" Article in the Evaluations.

- A. Receive, inspect, handle, and store switchboards according to [NECA 400] [NEMA PB 2.1].
 - 1. Lift or move switchboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
 - 2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
 - 3. Protect from moisture, dust, dirt, and debris during storage and installation.
 - 4. Install temporary heating during storage per manufacturer's instructions.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

Referenced NECA and NEMA standards in first paragraph below include similar requirements. See "Testing and Inspecting" Article in the Evaluations.

- A. Install switchboards and accessories according to [NECA 400] [NEMA PB 2.1].
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in

[Section 033000 "Cast-in-Place Concrete."] **[Section 033053 "Miscellaneous Cast-in-Place Concrete."]**

1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend **2 inches (50-mm)** above concrete base after switchboard is anchored in place.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to switchboards.
 6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

Retain first paragraph below if seismic controls are required for Project. Coordinate with Drawings. Where seismic mounting is required, bottom conduit entry is preferred.

- D. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. 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.
- F. Install filler plates in unused spaces of panel-mounted sections.
- G. Install overcurrent protective devices, surge protection devices, and instrumentation.

Subparagraph below assumes that settings are indicated on Drawings or a coordination report is available for Contractor to use.

1. Set field-adjustable switches and circuit-breaker trip ranges.

Retain first paragraph below if spare-fuse cabinets are specified in "Accessory Components and Features" Article.

- H. Comply with NECA 1.

3.3 CONNECTIONS

Coordinate this article with Drawings. Show locations and types of grounding connections available and which ones are used for grounding switchboards.

Coordinate busway and cable tray installations and specialty arrangements with schematics on Drawings and with requirements specified for busway and cable tray systems. Ensure that referenced Sections include required interfacing terminations necessary to attach to switchboards. If Drawings are explicit enough, these requirements may be reduced or omitted.

- A. Comply with requirements for terminating feeder bus specified in Section 262500 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.
- B. Comply with requirements for terminating cable trays specified in Section 260536 "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.
- C. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.
- D. Support and secure conductors within the switchboard according to NFPA 70.
- E. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment in front and rear with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

Retain "Testing Agency," "Manufacturer's Field Service," and "Perform the following tests and inspections" paragraphs below to identify who shall perform tests and inspections. If retaining second option in "Testing Agency" Paragraph or if retaining "Manufacturer's Field Service" or "Perform the following tests and inspections" Paragraph, retain "Field Quality-Control Reports" Paragraph in "Informational Submittals" Article.

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

Retain "Manufacturer's Field Service" Paragraph below to require a factory-authorized service representative to perform inspections, tests, and adjustments, especially if switchboards include zone-selective interlocking, remote monitoring and control, or both.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

Retain "Perform the following tests and inspections" Paragraph below to require Contractor to perform tests and inspections.

- C. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:
 - 1. Acceptance Testing:
 - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
 - b. Test continuity of each circuit.
 - 2. Test ground-fault protection of equipment for service equipment per NFPA 70.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification including all optional tests unless waived by Owner.. Certify compliance with test parameters.
 - 4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

- D. Switchboard will be considered defective if it does not pass tests and inspections.

Retain paragraph below if tests and inspections are performed by Contractor or manufacturer's field-service representative engaged by Contractor.

- E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- F. Infrared Scanning: After Substantial Completion and building occupancy, perform an infrared scan of switchboard connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.

2. Perform two follow-up infrared scans of switchboards, one at four months and the other at 11 months after Substantial Completion.
3. Prepare a certified report identifying switchboard checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

Select first option in paragraph below if settings are included in the Contract Documents; select second option if indicated Section is included in the Contract Documents.

- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

Select last option in paragraph below if retaining items in "Disconnecting and Overcurrent Protective Devices" Article above.

- A. [**Engage a factory-authorized service representative to train**] [**Train**] Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories[, **and to use and reprogram microprocessor-based trip, monitoring, and communication units**].

END OF SECTION 262413

DATA SHEETS LOW VOLTAGE SWITCHBOARDS		Equipment Name:	
DESCRIPTION	UNITS	SPEC DATA	VENDOR DATA
Manufacturer	N/A	By Manufacturer	
Model/Catalog No.	N/A	By Manufacturer	
SITE CONDITIONS			
Minimum Ambient Temperature	°C		
Maximum Ambient Temperature	°C		
Site Altitude Above sea Level	Ft		
SWITCHBOARD RATINGS			
Nominal System Voltage	V		
Maximum Operating Voltage	V		
No. Phases / No. Wires	Ph/W		
Frequency	Hz		
Bus Continuous Current Rating	A		
Assembly Short Circuit Rating (Minimum Sym. Current)	kA		
Bus System Short Circuit Rating (ANSI 4-cycle Sym)	kA		
Suitable For Service Entrance Equipment	Y/N		
Front and/or Rear Accessible	-		
ENCLOSURE			
NEMA Type	NEMA		
Weight as Installed	Lb	By Manufacturer	
Number of Poles	Qty.	By Manufacturer	
Switchboard Dimension (L x W x H)	Inches	By Manufacturer	
Cover Type (Hinged front cover, door-in-door, etc.)	-	By Manufacturer	
Color	ANSI	61 Gray	
BUS			
Material (Bus and Bus Extensions)	-	Copper	
Plating Material (Bus and Bus Extensions)	-	Silver	
100% Rated Neutral Bus	Y/N		
Full Length Ground Bus	-	Y	
Lug Material	-	By Manufacturer	
BREAKERS			
Model	-	By Manufacturer	
Main Breaker Frame Rating	A		
Main Breaker Trip Unit Sensor Rating	A		
Breaker Short Circuit Rating (Minimum Sym. Interrupting)	kA		
Breaker Options:			
Shunt Trip	Y/N		
Undervoltage Trip	Y/N		
Auxiliary Contacts	Y/N		
Key Interlock Kit	Y/N		
Handle Padlock	Y/N		
CONTROL POWER TRANSFORMER			

DATA SHEETS LOW VOLTAGE SWITCHBOARDS		Equipment Name:	
DESCRIPTION	UNITS	SPEC DATA	VENDOR DATA
Manufacturer/Model Number	-	By Manufacturer	
Power Source Location (Internal/External)	-		
Quantity	Qty		
Voltage - Primary	V		
Voltage - Secondary	V	120/240	
Power	kVA	By Manufacturer	
Control-Power Fuses	Qty		
TRIP UNITS			
Manufacturer/Model Number	-	By Manufacturer	
Standard Functions	-	L, S, I	
Instantaneous Defeat Capability	Y/N	Y	
Reduced Energy Let Through (RELT) Switch	Y/N		
Ground Fault Protection	Trip or Alarm	Trip	
Zone Selective Interlocking	Y/N	Y	
Integral Metering	Y/N		
SURGE PROTECTION DEVICES			
Manufacturer/Model Number	-	By Manufacturer	
Peak Surge Current Rating	A		
Voltage Protection Rating	V		
Nominal Rating	kA		
ACCESSORIES			
Accessories Set (Tools and miscellaneous items)	Y/N		
Space Heaters:			
Operating Voltage	VAC	120 VAC	
Battery System:	Y/N		
Operating Voltage	VDC		
Door Mounted Equipment:			
Control Buttons	Y/N		
Breaker Control Switches	Y/N		
Indication Lights	Y/N		
Test Switches	Y/N		
Separately Mounted Test Cabinet For EO Breakers	Y/N		
Mechanical Interlocks	Y/N		
Programming Software	Y/N		
Type of Programming Software	N/A		
Programming Hardware	Y/N		
Type of Programming Hardware	N/A		
SPECIAL REQUIREMENTS			

