PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general conditions, Division 26, and Basic Electrical Materials and Methods (Section 260500) are part of this section and the contract for this work and apply to this section as fully as if repeated herein.

B. Reference to other sections: The applicable requirements from other Division 26 sections required for a complete and operational system shall form a part of the electrical work and each section shall be thoroughly reviewed by the Contractor for application to all other sections.

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.

1.3 QUALITY ASSURANCE AND STANDARDS

A. All work, material or equipment shall comply with the codes, ordinances and regulations of the local government having jurisdiction, including the regulations of serving utilities and any participating government agencies having jurisdiction.

B. Equipment shown to scale is approximate only and based upon a general class of equipment specified. The Contractor shall verify all dimensions and clearances prior to commencement of work.

C. The Contractor shall verify all points of connection with the manufacturer's requirements, instructions, or recommendations prior to installation. The actual dimensions, weights, clearance requirements and installation requirements shall be verified and coordinated by the contractor.

D. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.4 SUBMITTALS

A. Submit shop drawings per Section 260500 for .

~~A.~~B. Action Submittals
1. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
   a. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
2. Shop Drawings: For each switchboard and related equipment.
   a. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
   b. Detail enclosure types for types other than NEMA 250, Type 1.
   c. Detail bus configuration, current, and voltage ratings.
   d. Detail short-circuit current rating of switchboards and overcurrent protective devices.
   e. Include evidence of NRTL listing for series rating of installed devices.
   f. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   g. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards.
   h. Include schematic and wiring diagrams for power, signal, and control wiring.

~~B.~~C. Informational Submittals
1. Qualification Data: For testing agency.
2. Seismic Qualification Certificates: For switchboards, overcurrent protective devices, accessories, and components, from manufacturer.
   a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
3. Field Quality-Control Reports:
   a. Test procedures used.
   b. Test results that comply with requirements.
   c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

~~C.~~D. Closeout Submittals
1. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
   a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      1) Routine maintenance requirements for switchboards and all installed components.
      2) Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
      3) Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards.

Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

~~D.~~E. Maintenance Material Submittals

1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   a. 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.
   b. 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.
   c. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

1.5 FIELD CONDITIONS

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

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 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.
   b. Altitude: Not exceeding 6600 feet.

1.6 COORDINATION

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.

1.7 WARRANTY

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.

1. Warranty Period: One 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.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   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.
   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."

2.2 SWITCHBOARDS

A. Acceptable manufacturers shall be Siemens, Eaton, or Square D.
   1. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. 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.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 2.

E. Comply with CEC.

F. Comply with UL 891.

G. Switchboards shall be factory assembled, dead-front, metal enclosed, self-supporting floor standing sections as noted in the construction documents.

H. Front-Connected, Front-Accessible Switchboards with sections front and rear aligned.

I. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
   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.
      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."

J. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.

K. 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.

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

M. Vertical sections shall contain overcurrent protective devices including circuit breakers and fuses and shall be nominally 90" in height.

N. Switchboard finish shall be baked enamel factory paint of manufacturer's standard color.

O. Provide front accessibility for wireways on each side of overcurrent protective devices for entire height of section. Provide welded steel framework with screw covers removable from the front; covers may be hinged.

P. All bussing shall be silver-coated copper (maximum 1000A/square inch current density) with ratings as indicated in the construction documents.

Q. 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.
2. Copper feeder circuit-breaker line connections.
3. Ground Bus: 1/4-by-2-inch- hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
4. 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.
5. 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.
6. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

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

S. Switchboard, bussing, and devices shall be fully-rated for the available short circuit current as determined by the Contractor's short circuit study (see 2.16 below), inclusive of all motor contribution and utility contribution. The minimum AIC ratings of the equipment may exceed those indicated on the construction documents, due to

the results of the Contractor's short circuit study. The Contractor shall include all study costs and resultant equipment costs during bidding. The Contractor may provide series-rated equipment, fully compliant with all CEC requirements and the short circuit study, but shall not provide series-rated equipment without explicit written permission from the Engineer.

T. Switchboards shall be equipped with lifting eyes.

U. Switchboards shall be suitable for the environment in which they are located and shall be NEMA 1, indoor, and rated for Seismic Design Category D, unless noted otherwise on the construction documents.

V. Main circuit breakers shall be provided and shall be insulated case solid-state (LSIG) trip type with ratings as noted. Main breakers shall be 100% rated devices.

W. Main circuit breaker shall be individually mounted, unless noted otherwise.

X. Main circuit breaker shall have maximum closing time of five (5) cycles, three (3) cycles upon opening.

Y. Main circuit breaker shall have field-replaceable trip plugs.

Z. Cross bussing shall be fully rated (maximum 1000A/square inch current density) for the length of the switchboard.

AA. Instrumentation shall be provided where noted. Owner metering shall be provided in accordance with the Owner's requirements.

BB. Instrument Transformers: NEMA EI 21.1, and the following:
1. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
3. 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.

CC. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
   a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
   b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
   c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
   d. Megawatts: Plus or minus 1 percent.
   e. Megavars: Plus or minus 1 percent.
   f. Power Factor: Plus or minus 1 percent.
   g. Frequency: Plus or minus 0.1 percent.
   h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.

i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
j. Contact devices to operate remote impulse-totalizing demand meter.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

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

EE. Provide permanently adhered “bakelite” labels indicating the identification of each device on the switchboard adjacent to the device and visible on the enclosure exterior.

FF. Provide a ground bus in each switchboard section with connecting ground bonds between sections. Ground bus shall be rated at 30% of the incoming capacity.

GG. Rodent-proof ventilation as required to maintain allowable temperature rise at rated capacity.

2.3 SURGE PROTECTION DEVICES

A. SPDs: Comply with UL 1449, Type 1.

B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1.
1. SPDs with the following features and accessories:
a. Integral disconnect switch.
b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
c. Indicator light display for protection status.
d. Form-C contacts rated at 5 A and 250-V ac, 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.
e. Surge counter.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
1. Line to Neutral: 1200 V for 480Y/277 V.
2. Line to Ground: 1200 V for 480Y/277 V.
3. Line to Line: 2000 V for 480Y/277 V.

E. SCCR: Equal or exceed 200 kA.

F. Nominal Rating: 20 kA.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, bolt-on type, with interrupting capacity to meet available fault currents.
   1. Frame size 400A and less: 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 250 A and larger.
   2. Frame size larger than 600A and more: Electronic Trip Circuit Breakers:
      a. RMS sensing.
      b. Field-replaceable rating plug or field-replicable electronic trip.
      c. Field-adjustable settings:
         1) Instantaneous trip.
         2) Long- and short-time pickup levels.
         3) Long and short time adjustments.
         4) Ground-fault pickup level, time delay, and I2t response where shown on drawings.
   3. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
   4. MCCB Features and Accessories:
      a. Standard frame sizes, trip ratings, and number of poles.
      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.
      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.

2.5 CONTROL POWER

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

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

C. 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

A. 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.

B. Portable Circuit Breaker Trolley Lift.

C. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.
   1. Lift or move panelboards 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

A. Installation method of switchboards shall comply with the 2013 edition of the California Electrical Code and the authority having jurisdiction.

B. Install all switchboards in accordance with the manufacturer’s recommendations and requirements.

C. Install switchboards and accessories according to NEMA PB 2.1.

D. Coordinate switchboard location and size with architectural and interior drawings. Coordinate with other trades to identify conflicts with switchboard locations and notify the Engineer of any conflicts.

E. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
   1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   2. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   3. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.

F. Coordinate switchboard size with concrete housekeeping pads to be constructed by others.

G. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

H. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

I. 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.

J. Install filler plates in unused spaces of panel-mounted sections.

K. Check all connections, phase rotation, ground resistance and insulation resistance levels.

L. Ground fault protective devices shall be tested by an approved third party testing agency and a written report submitted with the operation manual for review.

M. Test all switchboards and overcurrent protection devices for voltage level, continuity, ground fault, and short circuits.

N. Install all switchboards plumb and square to structure and adjacent surfaces.

O. Connect and inspect all ground bonds prior to energizing switchboard.

P. Demonstrate the proper operation of all ground fault protective devices.

Q. Clean all switchboard interiors and exteriors to be free of dirt, dust and debris prior to handing over to Owner. Touch up scratched paint and finishes as necessary.

R. Install overcurrent protective devices, surge protection devices, and instrumentation.

S. Adjust and set all devices for proper operation. Set all protective devices as per the written report recommendations.

T. Comply with NECA 1.

U. Comply with requirements for terminating feeder bus specified in Section 262500 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

V. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per CEC.

W. Support and secure conductors within the switchboard according to CEC.

X. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

Y. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

Z. 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."

3.3 FIELD QUALITY CONTROL

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

B. Perform the following tests and inspections:
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 CEC.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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. Perform the following infrared scan tests and inspections, and prepare reports:
a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
b. Instruments and Equipment:
1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

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

D. 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.

3.4 ADJUSTING

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

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

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to 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