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 the following enclosed controllers rated 600 V and less:
   1. Full-voltage manual.
   2. Full-voltage magnetic.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

G. SCR: Silicon-controlled rectifier.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. 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."

1.5 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: Currently certified by NETA to supervise on-site testing.

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

F. Comply with CEC.

G. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

1.6 SUBMITTALS

A. Submit shop drawings per Section 260500 for review.

B. Action Submittals
   1. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
   2. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
      a. Show tabulations of the following:
         1) Each installed unit's type and details.
         2) Factory-installed devices.
         3) Nameplate legends.
         4) Short-circuit current rating of integrated unit.
      b. Wiring Diagrams: For power, signal, and control wiring.

C. Informational Submittals
   1. Seismic Qualification Certificates: For enclosed controllers, 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.
   2. Field quality-control reports.
   3. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

D. Closeout Submittals
   1. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Routine maintenance requirements for enclosed controllers and installed components.
      b. Manufacturer's written instructions for setting field-adjustable overload relays.
      c. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

E. Materials Maintenance 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. 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.
      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: Two of each type and color installed.
      d. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
      e. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.7 FACTORY TESTING

A. Factory testing shall be provided for all motor control centers.

B. Factory test results shall be provided to the Engineer and Owner's Representative for review prior to shipment of motor control center.

C. All factory tests shall be made in strict accordance with ANSI and NEMA standards and shall be certified in writing.

D. All factory tests shall be available to be witnessed by the Owner's Representative, Consulting Engineer and Contractor at the factory upon advance request. Transportation, lodging and food shall be provided by the Contractor or Manufacturer. The schedule for witness testing shall be negotiated with the Owner's Representative

1.8 WARRANTY

A. Contractor shall guarantee equipment and installation free from defects in materials and workmanship for a period of one (1) year from the date of installation.

1.9 MANUFACTURERS

A. Manufacturers of the integrated Motor Control Center shall be Square-D, Eaton, or Siemens.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
1. Products: Subject to compliance with requirement, available products that may be incorporated into the Work include the following:
a. Square-D
b. Eaton
c. Siemens.
2. Configuration: Nonreversing.
3. Surface mounting.
4. Red pilot light.

C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Products: Subject to compliance with requirement, available products that may be incorporated into the Work include the following:
a. Square-D
b. Eaton
c. Siemens.
2. Configuration: Nonreversing.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
4. Surface mounting.
5. Red pilot light.

D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Products: Subject to compliance with requirement, available products that may be incorporated into the Work include the following:
a. Square-D
b. Eaton
c. Siemens.
2. Configuration: Nonreversing.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.
4. Surface mounting.
5. Red pilot light.
6. N.O. and N.C. auxiliary contact.

E. Magnetic Controllers: Full voltage, across the line, electrically held.
1. Products: Subject to compliance with requirement, available products that may be incorporated into the Work include the following:
a. Square-D

b. Eaton
c. Siemens.

2. Configuration: Nonreversing.
3. Contactor Coils: Pressure-encapsulated type.
   a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
   a. CPT Spare Capacity: 100 VA.
6. Bimetallic Overload Relays:
   a. Inverse-time-current characteristic.
   b. Class 20 tripping characteristic.
   c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
   d. Ambient compensated.
   e. Automatic resetting.
7. N.C. and N.O., isolated overload alarm contact.
8. External overload reset push button.

F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
1. Products: Subject to compliance with requirement, available products that may be incorporated into the Work include the following:
   a. Square-D
   b. Eaton
   c. Siemens.
2. Fusible Disconnecting Means:
   a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class R fuses.
   b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
3. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
4. Nonfusible Disconnecting Means:
   a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
   b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
   c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
5. MCP Disconnecting Means:
   a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
   b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
   c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.

d. N.C. and N.O. alarm contact that operates only when MCP has tripped.
e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

6. MCCB Disconnecting Means:
   a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
   b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
   d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
   e. N.C. and N.O. alarm contact that operates only when MCCB has tripped.

2.2 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
   1. Dry and Clean Indoor Locations: Type 1.
   2. Outdoor Locations: Type 3R.
   3. Wash-Down Areas: Type 4X, stainless steel.
   4. Other Wet or Damp Indoor Locations: Type 4.
   5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.3 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
   1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, type.
      a. Push Buttons: Lockable types; as indicated.
      b. Pilot Lights: LED types; colors as indicated.
      c. Selector Switches: Rotary type.

B. N.C. and N.O. auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

E. Cover gaskets for Type 1 enclosures.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Inspect installation and equipment for physical damage, proper alignment, anchorage, grounding, and completeness.

B. Check continuity of all circuits.

C. Check polarity and phasing of bussing.

D. Inspect bus bar spacing, insulators, wiring and devices for compliance with ANSI, CEC, and UL standards.

E. Check tightness of all bolted connections.

F. Check nameplates and identification.

G. The Contractor shall protect all equipment during shipping, delivery, storage, installations and at all times during construction. Motor control centers or their components shall not be exposed to weather, moisture, dust, dirt, debris or damage during construction (unless specifically rated for conditions).

3.2 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, 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.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

3.3 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 INSTALLATION

A. Install Motor Control Center in accordance with manufacturer's written instructions, NEMA standards, CEC requirements and any State or Owner requirements.

B. Comply with NECA 1.

C. Provide clean, level surface for installation with suitable structural strength. Verify compliance with Seismic Design Category D requirements.

D. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

E. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

F. Coordinate fuse type, fuse size, circuit breaker ratings, circuit breaker settings with available fault current, coordination study, and short circuit study. Install all fuses necessary.

G. Install fuses in each fusible-switch enclosed controller.

H. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

I. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

J. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved nameplate.
   3. Label each enclosure-mounted control and pilot device.

K. Provide ground continuity through means of driven ground rods, bonding to building steel, or bonding to building grounding electrode.

L. Install device handles to a height no greater than allowed by CEC or governing authority.

M. Coordinate installation and schedule with all other trades and Owner's Representative.

N. The Contractor shall coordinate all components including their arrangement electrically and mechanically.

O. The Contractor shall coordinate conduit entrances including method of entrance and connections.

P. The Contractor shall coordinate with all other trades necessary to provide a complete, proper installation. Grades, piping, structure, ducting, etc. shall be carefully reviewed by the Contractor prior to installation.

Q. The Contractor shall verify motor starting methods with the Mechanical Construction Documents and the Mechanical Contractor prior to ordering the motor control center. Immediately notify the Engineer of any discrepancies.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.
   1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
   2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
   2. Test continuity of each circuit.
   3. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
   4. Test each motor for proper phase rotation.
   5. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   6. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   7. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.

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

3.8 PROTECTION

A. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

1.1 CLEANING AND REPAIR

B. Repair and paint enclosure as necessary to return the enclosure to the original factory condition.

C. Damage to electrical components shall be repaired in the factory.

END OF SECTION