READ THIS FIRST

Notice to the Design Engineer, this document is part of Facilities and Infrastructure standards for Electrical Systems. Designers are advised to NOT use this template (*.doc) document as part of any project contract documents. Designers shall use the Port of Seattle MasterSpec specifications from the following link:

https://www.portseattle.org/page/guide-specifications.

Designers shall edit the corresponding Port's MasterSpec specification to meet the F&I Electrical Standard outlined in this specification. Note that Port's MasterSpec specifications contain specifications and languages for both Aviation and Maritime Divisions. F&I Standards are strictly for Aviation Division, and any Maritime related specs or languages should be removed from the project specifications.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY AND NOTES TO DESIGNER

A. Section includes MCCs for use with ac circuits rated 600 V and less and having the following factory-installed components:

1. Incoming main lugs and OCPDs.
2. Full-voltage magnetic controllers.
3. Reduced-voltage magnetic controllers.
4. Reduced-voltage, solid-state controllers.
5. Multispeed controllers.
6. VFDs.
7. Feeder-tap units.
8. TVSS.
9. Instrumentation.
10. Auxiliary devices.

B. Motor Control Centers (MCCs) may also be used for distribution of power to other than motor loads but are primarily applied to motor control.

C. Main Circuit Breaker is preferred but main lugs only MCC is allowed when user group has access to the circuit breaker feeding the MCC.

D. Provide meter on main circuit breaker. Coordinate metering requirements for feeder breakers/controller with F&I Utilities. Refer to Section 260913 – Electric Power Monitoring for metering requirements.

E. MCC Controller required for baggage conveyance systems only.

F. Provide Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays as required by project parameters and engineering considerations.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. EMI: Electromagnetic interference.

C. GFCI: Ground fault circuit interrupting.

D. LAN: Local area network.

E. LED: Light-emitting diode.

F. MCC: Motor-control center.

G. MCCB: Molded-case circuit breaker.

H. MCP: Motor-circuit protector.

I. NC: Normally closed.

J. NO: Normally open.

K. OCPD: Overcurrent protective device.

L. PT: Potential transformer.

M. RFI: Radio-frequency interference.

N. SCR: Silicon-controlled rectifier.

O. VFD: Variable frequency drive.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: MCCs 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 and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of controller and each type of MCC. Include shipping and operating weights, features, performance, electrical ratings, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each MCC, manufacturer's drawings as defined in UL 845. In addition to requirements specified in UL 845, include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.

1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
   a. Each installed unit's type and details.
   b. Factory-installed devices.
   c. Enclosure types and details.
   d. Nameplate legends.
   e. Short-circuit current (withstand) rating of complete MCC, and for bus structure and each unit.
   f. Features, characteristics, ratings, and factory settings of each installed controller and feeder device, and installed devices.
   g. Specified optional features and accessories.
2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring for each installed controller.
3. Nameplate legends.
4. Vertical and horizontal bus capacities.
5. Features, characteristics, ratings, and factory settings of each installed unit.

1.6 INFORMATIONAL SUBMITTALS

A. Standard Drawings: For each MCC, as defined in UL 845.

B. Production Drawings: For each MCC, as defined in UL 845.

C. Seismic Qualification Certificates: For MCCs, 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.

D. Qualification Data: For qualified testing agency.

E. Product Certificates: For each MCC, from manufacturer.

F. Source quality-control reports.

G. Field quality-control reports.

H. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

I. 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.

J. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For MCCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's Record Drawings: As defined in UL 845. In addition to requirements specified in UL 845, include field modifications and field-assigned wiring identification incorporated during construction by manufacturer, Contractor, or both.
2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
3. Manufacturer's written instructions for setting field-adjustable overload relays.
4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage, solid-state controllers.
5. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
6. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Standby Fuses: Furnish one spare for every five installed units, but no fewer than one set of three of each type.
2. Standby Indicating Lights: Furnish one spare for every five installed units, but no less than one set of three of each type.
3. Touch-up Paint: One pint container of paint matching enclosure finish packaged with protective covering for storage and identified with labels.

1.9 QUALITY ASSURANCE

A. 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.

B. Source Limitations: Obtain MCCs and controllers of a single type from single source from single manufacturer.

C. 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.

D. Comply with NFPA 70.

E. 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."

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver MCCs in shipping splits of lengths that can be moved past obstructions in delivery paths.

B. Handle MCCs according to the following:

1. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts."
2. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers."

C. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside MCCs; install temporary electric heating, with at least 250 W per vertical section.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
2. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
3. Humidity: Less than 95 percent (noncondensing).
4. Altitude: Exceeding 6600 feet, or 3300 feet if MCC includes solid-state devices.

1.12 COORDINATION

A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.

B. Coordinate features of MCCs, installed units, and accessory devices with remote pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each MCC, each controller, and each installed unit with ratings and characteristics of supply circuits, motors, required control sequences, and duty cycle of motors and loads.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. EATON
2. General Electric Company; GE Industrial Systems.
3. Square D; a brand of Schneider Electric.

B. General Requirements for MCCs: Comply with NEMA ICS 18, NEMA ICS 2.3 "Instructions for the Handling, Installation Operation and Maintenance of Motor Control Centers", and UL 845. Comply with NFPA 70 as adopted and administered by the Authority Having Jurisdiction.

C. MCC requires UL Service Entrance label where used as service entrance.

D. Equipment shall be rated for available fault current. Give consideration to future increases in available fault current when determining fault current rating for equipment.

2.2 FUNCTIONAL FEATURES

A. Description: Modular arrangement of main units, controller units, control devices, feeder-tap units, instruments, metering, auxiliary devices, and other items mounted in vertical sections of MCC.

B. Starting Methods: Starting methods may include but are not limited to the following:

1. Full Voltage, non-reversing
2. Full Voltage, reversing
3. Two-Speed One-Winding
4. Two-Speed Two Winding
5. Reduced-Voltage Autotransformer
6. Reduced-Voltage Part-Winding
7. Reduced-Voltage Wye/Delta open or closed transition
8. Variable frequency drives
9. Solid State Reduced Voltage
10. Solid State Reduced Voltage with contactor bypass
11. Solid-State Soft Start

C. Controller Units: Combination controller units.

1. Install units Size 1 through Size 5 on drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions. These units are standard and suitable for all applications and shall include:
   a. Motor Circuit Protector (MCP or HMCP) unless available fault current exceeds 65,000 Amps symmetrical. This device provides controller and motor disconnect means and overcurrent protection. Adjustable magnetic settings up to 1300% of motor FLA.
   b. Fused switches are allowed where available fault current exceeds 65,000 amps symmetrical, or for coordination reasons.
   c. Two normally open and two normally closed reversible auxiliary contacts minimum.
2. Motor controller preferred features include:
   a. Current sensor/microprocessor type overload protection with adjustable parameters including overcurrent, ground fault, phase loss phase unbalance, undervoltage, overvoltage.
   b. Silver plated contacts.
3. Equip units in Type B and Type C MCCs with pull-apart terminal strips for external control connections.

D. Feeder-Tap Units: Through 225-A rating shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

E. Future Units: Make provisions for extending horizontal bus for addition of vertical section in the future.

2.3 INCOMING MAINS

A. Main Circuit Breaker: Main circuit breaker is required when MCC is located where user group does not have access to MCC feeder circuit breaker.

1. Main circuit breaker shall be equipped with electronic trip or electronic programmable trip.
2. Monitoring of main overcurrent protective device is required except when the feeder to the MCC is monitored. See “Circuit Breaker Trip and Monitoring Requirements” schedule in appendix to Design Principles.

B. Main Lugs Only: Conductor connectors suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.

C. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time time adjustments.
   c. Ground-fault pickup level, time delay, and I^2t response where required.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5, if required by engineer of record.
5. 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, if required by engineer of record.
6. 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. Ground-Fault Protection: Integrally mounted or remote-mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator. Settings shall be provided by engineer of record.
   d. Communication Capability: See Section 260913 "Electrical Power Monitoring and Control" for communication requirements
   e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage, if required by engineer of record.
   f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay if required by engineer of record.
   g. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts

D. Insulated-Case Circuit Breaker: 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Full-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time time adjustments.
   c. Ground-fault pickup level, time delay, and I^2t response.
4. Remote trip indication and control.
5. Communication Capability: See Section 260913 "Electrical Power Monitoring" for communications requirements.
6. Control Voltage: 120-V ac.

2.4 COMBINATION CONTROLLERS

A. Full-Voltage Controllers:

1. General Requirements for Full-Voltage Enclosed Controllers: Comply with NEMA ICS 2, general purpose, Class A.
2. Magnetic Controllers: Full voltage, across the line, electrically held.
   a. Configuration: Nonreversing and reversing.

B. Reduced-Voltage Magnetic Controllers:

1. General Requirements for Reduced-Voltage Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A; closed transition; adjustable time delay on transition.
2. Reduced-Voltage Magnetic Controllers: Reduced voltage, electrically held.
   a. Configuration:
   b. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank. Open or closed transition.
   c. Part-Winding Controller: Separate START and RUN contactors, field-selectable for one-half or two-thirds winding start mode, with either six- or nine-lead motors; with separate overload relays for starting and running sequences.
   d. Autotransformer Reduced-Voltage Controller: Medium-duty service, with integral overtemperature protection; taps for starting at 50, 65, and 80 percent of line voltage; two START and one RUN contactors.

C. Reduced-Voltage, Solid-State Controllers:

1. General Requirements for Reduced-Voltage, Solid-State Controllers: Comply with UL 508.
2. Reduced-Voltage, Solid-State Controllers: An integrated unit with power SCRs, heat sink, microprocessor logic board, door-mounted digital display and keypad, bypass contactor, and overload relay; suitable for use with NEMA MG 1, Design B, polyphase, medium-induction motors.
   a. Configuration: Severe duty, reversible OR nonreversible.
   b. Starting Mode: Voltage ramping OR Current limit OR Torque control OR Torque control with voltage boost OR; field selectable.
   c. Stopping Mode: Coast to stop OR Adjustable torque deceleration OR Adjustable braking OR field selectable.
   d. Shorting (Bypass) Contactor: Operates automatically when full voltage is applied to motor, and bypasses the power semiconductors. Solid-state controller protective features shall remain active when the shorting contactor is in the bypass mode.
   e. Shorting and Input Isolation Contactor Coils, if needed: Pressure-encapsulated type; manufacturer's standard operating voltage, matching control power or line voltage, depending on contactor size and line-voltage rating. Provide coil transient suppressors**.**
   f. Logic Board: Identical for all ampere ratings and voltage classes, with environmental protective coating.

g. Adjustable acceleration-rate control using voltage or current ramp, and adjustable starting torque control with up to 400 percent current limitation for 20 seconds.

h. Keypad, front accessible; for programming the controller parameters, functions, and features; shall be manufacturer's standard and include not less than the following functions:
   1) Adjusting motor full-load amperes, as a percentage of the controller's rating.
   2) Adjusting current limitation on starting, as a percentage of the motor full-load current rating.
   3) Adjusting linear acceleration and deceleration ramps, in seconds.
   4) Initial torque, as a percentage of the nominal motor torque.
   5) Adjusting torque limit, as a percentage of the nominal motor torque.
   6) Adjusting maximum start time, in seconds.
   7) Adjusting voltage boost, as a percentage of the nominal supply voltage.
   8) Selecting stopping mode, and adjusting parameters.
   9) Selecting motor thermal-overload protection class between 5 and 30.
   10) Activating and de-activating protection modes.

i. Digital display, front accessible; for showing motor, controller, and fault status; shall be manufacturer's standard and include not less than the following:
   1) Controller Condition: Ready, starting, running, stopping.
   2) Motor Condition: Amperes, voltage, power factor, power, and thermal state.
   3) Fault Conditions: Controller thermal fault, motor overload alarm and trip, motor underload, overcurrent, shorted power semiconductors, line or phase loss, phase reversal, and line frequency over or under normal.

j. Controller Diagnostics and Protection:
   1) Microprocessor-based thermal protection system for monitoring power semiconductor and motor thermal characteristics, and providing controller overtemperature and motor overload alarm and trip; settings selectable via the keypad.
   2) Protection from line-side reverse phasing; line-side and motor-side phase loss; motor jam, stall, and underload conditions; and line frequency over or under normal.

k. For controllers without integral disconnects, provide input isolation contactor that opens when the controller diagnostics detect a faulted solid-state component, or when the motor is stopped.

l. For combination motor starter/disconnect, provide shunt trip that opens the disconnecting means when the controller diagnostics detect a faulted solid-state component.

m. Remote Output Features:
   1) All outputs prewired to terminal blocks.
   2) Form C status contacts that change state when controller is running.
   3) Form C alarm contacts that change state when a fault condition occurs.

n. Optional Features:

o. Analog output for field-selectable assignment of motor operating characteristics; 4 to 20-mA dc.
p. Additional field-assignable Form C contacts for alarm outputs.
q. Surge suppressors in solid-state power circuits providing three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.

D. Multispeed Magnetic Controllers:

1. General Requirements for Multispeed Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A.
2. Multispeed Magnetic Controllers: Two speed, full voltage, across the line, electrically held. Compelling relay to ensure that motor will start only at low speed.
   a. Configuration: One or two winding, reversing or Nonreversing, depending on application.
   b. Compelling relays shall ensure that motor starts only at low speed.
   c. Accelerating timer relays shall ensure properly timed acceleration through speeds lower than that selected.
   d. Decelerating timer relays shall ensure automatically timed deceleration through each speed.

E. Disconnecting Means and OCPDs:

1. Fusible Disconnecting Means:
   a. Used where available fault current exceeds 65,000A symmetrical or for coordination reasons
   b. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
   c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
   d. Auxiliary Contacts: Two normally open and two normally closed contacts, minimum.
2. 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.
3. 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 3/8 inch hasp padlocks and interlocks with cover in closed position.
4. Molded-Case Switch Disconnecting Means:

a. UL 489, NEMA AB 1, and NEMA AB 3, with in-line fuse block for Class J or L power fuses (depending on ampere rating), providing an interrupting capacity to comply with available fault currents; MCCB with fixed, high-set instantaneous trip only.
b. Lockable Handle: Accepts3/8 inch hasp padlocks and interlocks with cover in closed position.

F. Overload Relays:

1. Melting-Alloy Overload Relays:
   a. Inverse-time-current characteristic.
   b. Class 10 tripping characteristic.
   c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
2. Bimetallic Overload Relays:
   a. Inverse-time-current characteristic.
   b. Class 10 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.
3. Solid-State Overload Relays:
   a. Switch or dial selectable for motor running overload protection. Software selectable controls not allowed.
   b. Sensors in each phase.
   c. Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
   d. IP addressable communication module.
4. One each N.C. and N.O. reversible isolated overload alarm contact.
5. External overload reset push button.

G. Control Power:

1. Control Circuits: 120V ac; obtained from integral CPT, with primary and secondary overcurrent protection, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
   a. CPT Spare Capacity: Size CPT at least one size above minimum VA requirements.
   b. When an external control power source be required, provide auxiliary contacts, mechanically tied to the combination starter-disconnect switch and wired so that control power within the motor starter module will be disconnected when the motor power disconnect is opened.
   c. The secondary of the CPT shall have one leg grounded. No switching of coils shall be allowed between the coil and the groundside.

2.5 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. PTs: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: IEEE C57.13; 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.
3. CPTs: Dry type.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. EATON PXM 2000 or 6000/8000 series meter..
2. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
3. Switch-selectable digital display of the following values with the indicated maximum accuracy tolerances:
   a. Phase Currents, Each Phase: Plus or minus 1 percent.
   b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
   c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
   d. Three-Phase Real Power (Megawatts): Plus or minus 2 percent.
   e. Three-Phase Reactive Power (Megavars): Plus or minus 2 percent.
   f. Power Factor: Plus or minus 2 percent.
   g. Frequency: Plus or minus 0.5 percent.
   h. Accumulated Energy, Megawatt Hours: Revenue grade, plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
   i. Contact devices to operate remote impulse-totalizing demand meter.
4. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

C. Communication: Modbus, TCP/IP, Ethernet compatible.

2.6 MCC CONTROL POWER

A. Provide for baggage conveyor controls only.

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

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

1. Provide amber blown fuse indicator on front enclosure.

D. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.7 ENCLOSURES

A. 600V class, deadfront, freestanding.

B. Indoor Enclosures:

1. For clean, dry locations: freestanding steel cabinets unless otherwise indicated. NEMA 250, Type 1A unless otherwise indicated to comply with environmental conditions at installed location.
2. Locations subject to wet or dry contaminants: NEMA Type 12.

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

D. Outdoor Enclosures: Type 3R.

1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
2. Enclosure: Downward, rearward sloping roof; bolt-on rear covers for each section, with provisions for padlocking.
   a. Factory-installed electric unit heater(s), wall or ceiling mounted, with integral thermostat and disconnect and with capacities to maintain switchboard interior temperature of 40 deg F with outside design temperature of 104 deg F.
   b. Ventilating openings.
   c. Thermostat: Single stage; wired to control heat.
3. Power for Space Heaters: Include a CPT within the switchboard. Supply voltage shall be 120-V ac.
4. Front Access is standard and preferred. Front and rear mounted starter units and circuit breakers acceptable if warranted by design constraints.

E. Compartments: Modular; individual 120° swing doors with concealed hinges and quick-captive screw fasteners. Interlocks on units requiring disconnecting means in off position before door can be opened or closed, except by operating a permissive release device.

F. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC; same size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.

G. Wiring Spaces:

1. Vertical wireways in each vertical section for vertical wiring to each unit compartment; supports to hold wiring in place if required by engineer of record.
2. Horizontal wireways in bottom and top of each vertical section for horizontal wiring between vertical sections as required by engineer of record; supports to hold wiring in place.

H. No cabling shall be allowed for any interconnections of MCC sections unless approved by F&I.

2.8 AUXILIARY DEVICES

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: Industrial -duty, oiltight where required.
   a. Push Buttons: 120V, 20A industrial grade, nylon, NEMA 13.
   b. Pilot Lights: 120V, Oil-tight transformer LED type preferred; push to test lights shall be red “running” and green “ready” mounted in front panel of individual modules.
   c. Selector Switches: Standard control for remotely controlled motors is rotary Hand-Off Auto switch mounted in front panel of each module.
2. Elapsed-Time Meters: Heavy duty with digital readout in hours**,** nonresettable.
3. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus 2 percent accuracy with selector switches having an off position.

B. Two reversible NC/NO contactor auxiliary contacts per module.

C. Control Relays: Auxiliary and adjustable solid-state 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. Space heaters, with NC auxiliary contacts, to mitigate condensation in enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

F. Spare control-wiring terminal blocks**,** unwired.

G. Standby Fuse Cabinet: Identified cabinet with hinged lockable door.

2.9 CHARACTERISTICS AND RATINGS

A. Wiring: NEMA ICS 18, Class II Type B is standard. Other NEMA classifications acceptable where warranted by application.

B. Control and Load 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.

C. Nominal System Voltage: 480Y/277 V, three phase, four wire.

D. Short-Circuit Current Rating for Each Unit: Fully rated, 65 kA.

E. Short-Circuit Current Rating of MCC: Fully rated] with its main overcurrent device; 65 kA.

F. Environmental Ratings:

1. Ambient Temperature Rating: Not less than 0 deg F and not exceeding 104 deg F, with an average value not exceeding 95 deg F over a 24-hour period.
2. Ambient Storage Temperature Rating: Not less than minus 4 deg F and not exceeding 140 deg F.
3. Humidity Rating: Less than 95 percent (noncondensing).
4. Altitude Rating: Not exceeding 6600 feet, or 3300 feet if MCC includes solid-state devices.

G. Main-Bus Continuous Rating: 600A minimum continuous rating.

H. Vertical-Bus Minimum Continuous Rating: 300 A.

I. Horizontal and Vertical Bus Bracing (Short-Circuit Current Rating): Match MCC short-circuit current rating.

J. Main Horizontal and Equipment Ground Buses: Uniform capacity for entire length of MCC's main and vertical sections. Provide for future extensions. Main horizontal bus preferably at top. NO ALUMINUM BUS WILL BE ALLOWED.

K. Vertical Phase and Equipment Ground Buses: Uniform capacity for entire usable height of vertical sections, except for sections incorporating single units.

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

M. Neutral Buses: Provide neutral bus and neutral conductor for all MCCs. Neutral bus shall be rated for 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables.

N. Ground Bus: ¼ inch by one inch hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit equipment grounding conductors.

O. Bus Withstand Rating: 65 kA rms.

P. Provide bus isolating mechanism when draw-out units are removed.

Q. Front-Connected, Front-Accessible MCCs:

1. Main Devices: Fixed mounted.
2. Controller Units: Fixed mounted.
3. Sections front and rear aligned.

R. Owner Metering Compartment: A separate customer metering compartment and section with front hinged door, metering, and current transformers for each meter.

Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.

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

T. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of unit.

2.10 SOURCE QUALITY CONTROL

A. MCC Testing: Inspect and test MCCs according to requirements in NEMA ICS 18.

B. MCCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - INSTALLATION

3.1 EXAMINATION

A. Examine areas and surfaces to receive MCCs, with Installer present, for compliance with requirements for installation tolerances 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.

3.2 MOTOR CONTROL CENTER INSTALLATION

A. Coordinate layout and installation of MCCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Floor-Mounting Controllers: Install MCCs on 3-1/2-inch nominal thickness concrete base. Concrete shall be rated for 3000 psi minimum. Comply with requirements in Section 260548.16 “Seismic Controls for Electrical Systems”.

1. 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. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Concrete bases shall be leveled to no more than 0.25 inches of deviation for every 3 feet in ALL directions.
6. Contractor shall notify F&I and AV Maintenance prior to concrete pour to measure concrete base and assess base's levelness.
7. Concrete bases shall have smooth finishes. Broom finishes are prohibited.

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

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in each fusible switch.

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

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

H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

I. Install power factor correction capacitors. Connect to the line OR load side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.

J. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification of MCC, MCC components, and control wiring.

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label main circuit breakers or main lugs as applicable, showing location and device number of source circuit breaker or fused switch.
3. Label MCC and each cubicle with engraved nameplate.
4. Label each enclosure-mounted control and pilot device.
5. Mark up a set of manufacturer's connection wiring diagrams with field-assigned wiring identifications and return to manufacturer for inclusion in Record Drawings.

B. Operating Instructions: Frame printed operating instructions for MCCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of MCCs.

3.4 CONTROL WIRING INSTALLATION

A. Install Type IIB wiring is required throughout MCC. 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 within 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.

3.5 CONNECTIONS

A. Comply with requirements for installation of conduit in Section 260533 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

C. Torque all lugs per manufacturer's recommendations. When manufacturer's recommendations are unavailable, use UL 486A and 486B for torque values. Place spot of red paint on lugs after torqueing such that paint will be visibly disturbed if lugs are disturbed.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections as described below.

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. Check phase rotation of all conductors and ensure proper color-coding.
3. Megger test MCC with all breakers open before energizing.
4. Test insulation resistance for each enclosed controller element, component, connecting motor supply, feeder, and control circuits.
5. Test continuity of each circuit.

6. Verify that voltages at controller locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Port before starting the motor(s).
7. Test each motor for proper phase rotation.
8. Verify continuity and tightness of ground connections.
9. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
10. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
11. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
    a. Initial Infrared Scanning: Two weeks after Substantial Completion, and before Final Acceptance, perform an infrared scan of each multipole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: The Port shall have the option of performing its own infrared inspection.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
12. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
13. Mark up a set of manufacturer's drawings with all field modifications incorporated during construction and return to manufacturer for inclusion in Record Drawings.

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 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

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

B. Set motor overloads per manufacturer’s tables for actual motor nameplate Full Load Amps.

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

D. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Set MCPs as low as possible without causing nuisance tripping

E. Where motor controllers with CT/Microprocessor overloads are employed, set all adjustable parameters per Engineer's instructions.

F. Set the taps on reduced-voltage autotransformer controllers as required by engineer or the driven load manufacturer's recommendation.

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

H. Program microprocessors in VFCs for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

I. Set field-adjustable circuit-breaker trip ranges as directed by the engineer of record.

3.9 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

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

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers, and to use and reprogram microprocessor-based, reduced-voltage, solid-state controllers.

END OF SECTION 262419