



**Harrisonburg-Rockingham Regional
Sewer Authority**

Electrical Building 1 Improvements
Electrical Gear Procurement

NOT FOR CONSTRUCTION

HRRSA RFP No. HRRSA-2021-05
Wiley|Wilson Comm. No. 2192017.00

February 26, 2020



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SECTION 262419 - MOTOR-CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Owner's Request for Proposal (RFP) documents.

1.2 SUMMARY

- A. Section includes MCCs for use with ac circuits rated 600 V and less, with combination controllers and having the following factory-installed components:
 - 1. Main disconnect and overcurrent protective devices.
 - 2. Automatic power transfer.
 - 3. Magnetic Controllers
 - 4. Feeder-tap units.
 - 5. Measurement and control.
 - 6. Auxiliary devices.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCC: Motor-control center.
- C. MCCB: Molded-case circuit breaker.
- D. MCP: Motor-circuit protector.
- E. OCPD: Overcurrent protective device.
- F. PT: Potential transformer.
- G. SPD: Surge protective device.
- H. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for MCCs.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories for each cell of the MCC.
- B. Shop Drawings: For each MCC, manufacturer's approval 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 Wiring Diagrams: For power, signal, and control wiring for each installed controller.
 3. Schematic Wiring Diagrams: For power, signal, and control wiring for main-tie-main breaker transfer scheme.
 4. Nameplate legends.
 5. Detailed bus configuration with vertical and horizontal bus capacities.
 6. Features, characteristics, ratings, and factory settings of each installed unit.

1.5 INFORMATIONAL SUBMITTALS

- A. Production Drawings: For each MCC, as defined in UL 845.
- B. Seismic Qualification Data: 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.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For MCCs, all installed devices, and components to include in emergency, operation, and maintenance manuals.
 - 1. Include the following:
 - 2. Manufacturer's Record Drawings: As defined in UL 845. In addition to requirements specified in UL 845.
 - 3. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - 4. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 5. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Indicating Lights: Two of each type and color installed.
 - 4. Auxiliary Contacts: Furnish two spare(s) for each size and type of magnetic controller installed.
 - 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain MCCs and controllers of a single type from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, and marked for intended use.
- C. UL Compliance: MCCs shall comply with UL 845 and shall be listed and labeled by a qualified testing agency.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. 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."

- B. 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.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace MCC that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Eighteen (18) months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Products specified are based on the listed Basis of Design equipment to establish a standard of quality for design, function, compatibility of materials, and to fit within the space with required working clearances. The Owner or the Owner's technical representative will be the sole judge of the basis of what is equivalent. Only products by alternative manufacturers listed below that have equivalent functionality and will achieve the necessary requirements for installation in the available space may be proposed:
 - 1. Schneider Electric (Basis of Design)
 - 2. Allen Bradley
 - 3. Eaton

2.2 SYSTEM DESCRIPTION

- A. NEMA Compliance: Fabricate and label MCCs to comply with NEMA ICS 18.
- B. Ambient Environment Ratings:
 - 1. Ambient Temperature Rating: Not less than 0 deg F and not exceeding 104 deg F.
 - 2. Humidity Rating: Less than 95 percent (noncondensing).
 - 3. Altitude Rating: Not exceeding 6600 feet.
- 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.

2.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: MCCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 Risk Category III, Design Category B.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
2. Component Importance Factor: 1.5.
3. Component Amplification Factor: 2.5.
4. Component Response Modification Factor: 6.0.

B. Capacities and Characteristics:

1. MCC Enclosure and Assembly:
 - a) Nominal System Voltage: 277/480-V ac.
 - b) Service Equipment Rated: Yes.
 - c) Enclosure: NEMA 250, Type 1A.
2. Integrated Short-Circuit Rating for MCC:
 - a) Fully rated; 42 kA.
3. Integrated Short-Circuit Rating for Each Unit:
 - a) Fully rated; 42 kA.
4. Wiring Class: Class 2, Type B.
5. Bus:
 - a) Horizontal Bus: 42 kA.
 - b) Neutral Bus: Full size and continuous across all sections.
6. Main Disconnect Device:
 - a) Main Disconnect: MCCB, UL 489, three pole, 1000 A. Manually and electrically operated, electrically tripped.
 - b) SPD: UL 1449, Type 2.
7. Automatic Power Transfer: Electrically operated MCCBs, three pole, 1000 A.
8. Magnetic Controllers:
 - a) Refer to one line diagram for equipment tag number and motor horsepower rating.
 - 1) Classification by Starting Method: Full voltage, nonreversing.
 - 2) Controller Size: As indicated one complying with NEMA ICS 2.
 - 3) Optional Features: Custom motor control schematics.
9. Controller-Mounted Auxiliary Devices:
 - a) Push Buttons and Selector Switches: Heavy-duty, oiltight type.
 - b) Feeder Tap Units: Main Disconnect: MCCB, UL 489, three pole, Amp rating as indicated on one line diagram. Manually operated, electrically tripped.

2.4 MOTOR CONTROL CENTER ENCLOSURES

- A. Indoor Enclosures: Freestanding steel cabinets unless otherwise indicated. NEMA 250, Type 1A unless otherwise indicated to comply with environmental conditions at installed location.
- B. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

2.5 ASSEMBLY

- A. Structure:
 - 1. Comply with UL requirements for service entrance equipment.
 - 2. Units up to and including Size 3 shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
 - 3. Units in Type B and Type C MCCs shall have pull-apart terminal strips for external control connections.
- B. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners.
 - 1. Interlock compartment door to require that the disconnecting means is "off" before door can be opened or closed, except by operating a concealed release device.
 - 2. Compartment construction shall allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC.
 - 3. The same-size compartments shall be interchangeable to allow rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
- C. Bus Transition Sections: Included and aligned with the structure of the MCC.
- D. 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.
- E. Wiring Spaces:
 - 1. Vertical wireways in each vertical section for vertical wiring to each unit compartment; supports to hold wiring in place.
 - 2. Horizontal wireways in bottom and top of each vertical section for horizontal wiring between vertical sections; supports to hold wiring in place.
- F. Provisions for Future:
 - 1. Compartments marked "future" shall be bused, wired and equipped with guide rails or equivalent, and ready for insertion of drawout units.
 - 2. Compartments marked "spare" shall include provisions for connection to the vertical bus.

- G. Integrated Short-Circuit Rating:
 - 1. Short-Circuit Current Rating of MCC: Fully rated with its main overcurrent device; 42 kA.
- H. Control Power:
 - 1. 120-V ac; obtained from CPT integral with controller; with primary and secondary fuses. The CPT shall be of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
- I. Factory-Installed Wiring: Factory installed, with bundling, lacing, and protection included. Use flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.
 - 1. Wiring Class: NEMA ICS 18, Class II, Type B, for starters larger than Size 3 Type B-T, for starters Size 3 and smaller.
 - 2. Control and Load Wiring: Factory installed, with bundling, lacing, and protection included. Use flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.
- J. Bus:
 - 1. Main Horizontal and Equipment Ground Buses: Uniform capacity for entire length of MCC's main and vertical sections. Provide for future extensions from both ends.
 - 2. Vertical Phase and Equipment Ground Buses: Uniform capacity for entire usable height of vertical sections, except for sections incorporating single units.
 - 3. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent minimum conductivity or tin-plated alloy, with mechanical connectors for outgoing conductors.
 - 4. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector for ground conductors, minimum size 1/4-by-2 inches. Equip with mechanical connectors for outgoing conductors.
 - 5. Neutral Disconnect Link: Bolted, uninsulated, 1/4-by-2-inch copper bus, arranged to connect neutral bus to ground bus.

2.6 MAIN DISCONNECT AND OVERCURRENT PROTECTIVE DEVICE(S)

- A. MCCB (to 2500 A): Fixed mounted, manually operated air-circuit breaker. Comply with UL 489.
 - 1. MCCB shall have quick-make, quick-break, over-center switching mechanism that is mechanically trip-free, its position shall be shown by the position of the handle, and manual push-to-trip push button.
 - 2. Solid-state monitoring and tripping system to show system status monitoring, adjustable time-current protection, and shunt trip.
 - a) Interchangeable current sensors and timing circuits for adjustable time-current protection settings and status signals.
 - b) Trip-setting dials or interchangeable plugs to establish the continuous trip of the circuit breaker. Plugs shall not be interchangeable between frames, and the breaker may not be closed without the plug. With neutral ground-fault sensor.
 - c) Time-current adjustments to achieve protective-device coordination as follows:

- 1) Adjustable long-time delay.
 - 2) Adjustable short-time setting and delay to shape the time-current curve.
 - 3) Adjustable instantaneous setting.
 - 4) Individually adjustable ground-fault setting and time delay.
 - d) Built-in digital ammeter display, showing load current and tripping cause.
3. Switch operator power shall be from control power specified in "Assembly" Article.
- B. Surge Suppression: Factory installed as an integral part of the incoming feeder, complying with UL 1449, SPD Type 2.

2.7 AUTOMATIC POWER TRANSFER

A. Main-Tie-Main Breaker Transfer Control:

1. Transfer control, using electrically operated MCCBs, for an MCC supplied from two normally energized low-voltage power sources, designated "normal/Source A" and "standby/Source B." The circuit breakers connecting the two power sources to the load bus and the tie breaker shall be controlled by a microprocessor-based automatic transfer control. Power for the transfer control shall be from the voltage-sensing transformers.
2. MCCBs (to 2500 A): Fixed mounted, manually operated air-circuit breaker. Comply with UL 489.
 - a) MCCB shall have quick-make, quick-break, over-center switching mechanism that is mechanically trip-free, its position shall be indicated by the position of the handle, and manual push-to-trip push button.
 - b) Solid-state monitoring and tripping system to show system status monitoring, adjustable time-current protection, and shunt trip.
 - 1) Interchangeable current sensors and timing circuits for adjustable time-current protection settings and status signals.
 - 2) Trip-setting dials or interchangeable plugs to establish the continuous trip of the circuit breaker. Plugs shall not be interchangeable between frames, and the breaker may not be closed without the plug. With neutral ground-fault sensor.
 - 3) Time-current adjustments to achieve protective-device coordination as follows:
 - a) Adjustable long-time delay.
 - b) Adjustable short-time setting and delay to shape the time-current curve.
 - c) Adjustable instantaneous setting.
 - d) Individually adjustable ground-fault setting and time delay.
 - 4) Built-in digital ammeter display, showing load current and tripping cause.
3. In the manual mode, all automatic transfers shall be disabled and permit local operation of both mains and the tie breaker, but shall maintain permissives that inhibit closing of both main breaker simultaneously while the tie breaker is closed.

4. In the automatic mode, the load bus is connected to the normal power source with the tie breaker closed. When the normal source fails, the control shall automatically open the normal power source and close the standby source circuit breaker.
5. Sequence of Operation:
 - a) The default operation shall be with the normal source main breaker closed, standby main breaker open, and the tie breaker closed. On detection of an undervoltage to the line side of the normal main breaker and after a field-adjustable time delay, the main breaker shall open and, after an additional field-adjustable time delay, the standby breaker shall close and restore power to the facility.
 - b) On restoration of voltage to the line side of the normal main breaker and after a field-adjustable time delay, the standby main breaker shall open and, after a field-adjustable time delay, the normal main breaker shall close.
6. Field-Adjustable Transfer Parameters:
 - a) Delay the transfer from the normal power source to the standby power source and from the standby power source to the normal source. The time delay is to allow the load voltage to decay before reconnecting to another power source. Delay range is zero seconds to 30 minutes.
 - b) Delay the initiation of the transfer sequence. The time delay is recommended to override a momentary power outage or voltage fluctuation. Delay range is zero to 120 seconds.
 - c) Delay the transfer from the standby power source to the normal power source. Delay range is zero seconds to 30 minutes.
 - d) A relay with contact that changes state when the power is available on the normal source, and a relay with contact that changes state when the power is available on the standby source.
7. Controls and Indicators: In addition to the delay setting controls, include the following:
 - a) Interlocks or relay control to prevent transfer when either of the two controlled circuit breakers trip due to overcurrent or ground-fault.
 - b) Three-position keyed selector switch to select the normal source: Source 1, Source 2, or none.
 - c) Two-position keyed selector switch to transfer-control automatic and manual selector.
 - 1) Interlock shall prevent paralleling of the two power sources in manual mode.
 - d) Two-position keyed selector switch to select manual or automatic retransfer mode.
 - e) Open-close illuminated push buttons for manual electrical operation of each controlled circuit breaker.
 - f) Three-position keyed selector switch for transfer testing: Main A test, normal, and Main B test.
 - g) Meters and display to show the following:
 - 1) Voltage and frequency of both sources.
 - 2) A multiline display showing the following:

- a) Set points of timers, and voltage pickup and dropout set points.
 - b) Date, time, and reason for minimum of the last 10 transfers. The display may show the information for one transfer at a time using a scrolling control, with the others held in memory.
 - c) When the control system is in the transferring process, the display shall show delay countdown in seconds.
- h) LED indicators to show the following:
- 1) Normal source available.
 - 2) Standby source available.
 - 3) Normal breaker open
 - 4) Normal breaker closed.
 - 5) Normal breaker fault
 - 6) Standby breaker open.
 - 7) Standby breaker closed.
 - 8) Standby breaker fault.
 - 9) Tie breaker open.
 - 10) Tie breaker closed.
 - 11) Tie breaker fault.
 - 12) Auto mode status.
 - 13) Manual mode status.
 - 14) Auto transfer fail.
 - 15) UPS/PLC Battery fail.
8. Voltage Transformers: Primary and secondary protection and disconnecting means for sensing functions and control power. Provide internal UPS to supply continuous control power during transfers or minor outages.

2.8 MAGNETIC CONTROLLERS

A. Controller Units: Combination controllers.

B. Disconnects:

1. MCP:

- a) UL 489, with interrupting capacity complying 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: For three padlocks and interlocks with cover in closed position.

C. Controllers: Comply with UL 508.

- 1. Full-Voltage Magnetic Controllers: Electrically held, full voltage, NEMA ICS 2, general purpose, Class A.
 - a) Classification: Nonreversing.

D. Overload Relays:

1. Solid-State Overload Relays:

- a) Switch or dial selectable for motor-running overload protection.
- b) Sensors in each phase.
- c) Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

2. NO isolated overload alarm contact.
3. External overload reset push button.

2.9 CONTROLLER-MOUNTED AUXILIARY DEVICES

A. Control-Circuit and Pilot Devices: Factory installed in controller enclosure cover unless otherwise indicated. Comply with NEMA ICS 5.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.

- a) Push Buttons: Shrouded types; momentary contact unless otherwise indicated.
- b) Pilot Lights: LED types; Red and green; push to test.
- c) Selector Switches: Rotarytype.

B. Elapsed-Time Meters: Heavy duty with digital readout in hours; resettable.

C. 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.

D. Auxiliary Dry Contacts: NO.

E. Control Devices:

1. Door-mounted hand-off-auto switch.

2.10 MEASUREMENT AND CONTROL DEVICES

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

1. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; bar or window type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
2. CPTs: 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, for selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker and ground-fault protection.

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

1. Listed or recognized by a nationally recognized testing laboratory.

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: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
 - i) Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.
 - j) Contact devices to operate remote impulse-totalizing demand meter.
 4. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
- C. Control Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

2.11 FEEDER TAP UNITS

- A. MCCBs (to 1200 A): Fixed mounted, with 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. Comply with UL 489, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
1. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 2. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - a) Instantaneous trip.
 - b) Long- and short-time pickup levels.
 - c) Long- and short-time time adjustments.
 - d) Ground-fault pickup level, time delay, and I^2t response.

2.12 SOURCE QUALITY CONTROL

- A. MCC Testing: Test and inspect 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 - EXECUTION

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

3.2 INSTALLATION

- A. NEMA Industrial Control and Systems Standards: Comply with parts of NEMA ICS 2.3 for installation and startup of MCCs.
- B. Floor Mounting: Install MCCs on 4-inch nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 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.
- C. Seismic Bracing: Comply with requirements specified by manufacture.
- 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 control circuits if not factory installed.
- F. Adjust solid state overload relays based on actual nameplate full-load amperes after motors have been installed.
- G. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Provide identification of MCC, MCC components, and control wiring.
 - 1. Label MCC and each cubicle with engraved nameplate.
 - 2. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's central-control system or field devices. Bundle, train, and support wiring in enclosures.

- B. Connect interconnections between MCC shipping splits, as identified by manufacture.
- 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 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- 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. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. MCCs will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to NETA Acceptance Testing Specification and manufacturer's written instructions.

3.7 ADJUSTING

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

and attempt to start motors several times, allowing for motor cool-down 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 Owner before increasing settings.

- C. Set field-adjustable circuit-breaker trip ranges.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262419



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