

[PROJECT NUMBER]
[DATE]

[PROJECT NAME]
[PROJECT LOCATION]

ROCKWELL AUTOMATION

PROCUREMENT SPECIFICATION

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Low Voltage NEMA Motor Control Centers

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PART 1 General

1.01 SCOPE

- A. This section includes the requirements for 600V-class low voltage motor control centers (MCCs) for use on alternating current power systems.
- B. The MCCs shall be furnished and installed as specified in this section and as shown on the contract drawings.

1.02 RELATED SECTIONS

- A. Section 26 28 00 Circuit Breakers and Fusible Switches.
- B. Section 26 29 13.13 Low Voltage Controllers - Across the Line Motor Controllers.
- C. Section 26 29 13.16 Low Voltage Controllers - Solid State Reduced Voltage Starters.
- D. Section 26 29 23 Variable Frequency Drives.
- E. Section 26 36 00 Automatic Transfer Switch.
- F. Section 26 43 13 Transient-voltage Suppression for Low Voltage Electrical Power Circuits.

1.03 REFERENCES

- A. The MCC shall meet or exceed the requirements within the following standards for MCCs.
 - 1. NEMA ICS 18 - Industrial Control and Systems: Motor Control Centers
 - 2. UL 845 - UL Standard for Safety for Motor Control Centers
NOTE: UL 845 is a harmonized standard consisting of:
 - a) Underwriters Laboratories Inc. (UL) UL 845
 - b) Canadian Standards Association (CSA) C22.2 No. 254-05
 - c) Association of Standardization and Certification (ANCE) NMX-J-353-ANCE-2006
 - 3. NFPA 70 - National Electrical Code
- B. The MCC shall be designed, manufactured, and tested in facilities registered to ISO 9001.

If an arc resistant MCC is required, include the following specification point. For more information on when arc resistant MCCs are available and can be specified, see the informational page at the end of this document.

- C. Arc-resistant or arc-containing low voltage MCCs shall be tested, rated, and labeled in accordance with the requirements of IEEE C37.20.7 'IEEE Guide for Testing Metal-enclosed Switchgear Rated up to 38 kV for Internal Arcing Faults'.

1.04 DESIGN REQUIREMENTS

- A. Provide MCC based on applicable NEMA and UL standards and in accordance with the detailed contract specifications and drawings.
- B. The manufacturer of the MCC shall also be the manufacturer of the across-the-line motor starters, across-the-line contactors, solid-state reduced voltage starters, and variable frequency drives. The use of third-party supply and assembly for these components in the motor control center is not acceptable.
- C. The contractor shall confirm motor full-load amperage ratings and provide those ratings to the MCC manufacturer to achieve proper sizing of the drives, soft starters, motor branch circuit, and overload protection.

1.05 PRE-MANUFACTURE SUBMITTALS

- A. Refer to Section [xx xx xx] for submittal procedures.
- B. Manufacturer Drawings.
 - 1. MCC elevations showing dimensional information including details such as, but not limited to, the following:
 - a) MCC height (less any removable lifting angles or eyes)
 - b) MCC width
 - c) MCC depth
 - d) Location of shipping splits
 - 2. Structure descriptions showing the following:
 - a) Bus ratings
 - b) Enclosure ratings
 - c) Short-circuit withstand ratings
 - d) Other information as required for approval
 - 3. Conduit locations
 - 4. Required bus splices
 - 5. Unit descriptions including information such as, starter sizes, circuit breaker frame sizes, circuit-breaker continuous ampere ratings, and pilot devices
 - 6. Nameplate information
 - 7. Schematic wiring diagrams
 - 8. Manufacturer drawings shall be provided in PDF format
 - 9. Manufacturer drawings do not need to be stamped if a drawing schedule is provided that lists the drawing numbers, version levels, and status of drawings (such as, preliminary, approval, and final)

C. Product Data.

1. Data sheets and publications on all major components including, but not limited to, the following:
 - a) Motor starters
 - b) Overload relays
 - c) Circuit breaker and fuse information including time current characteristics
 - d) Control power transformers
 - e) Pilot devices
 - f) Relays

D. Specification Response.

1. All clarifications and exceptions must be clearly identified

E. Installation Instructions.

1. Provide a copy of the manufacturer's installation instructions that includes the following:
 - a) Receiving, handling, and storage instructions
 - b) General description for reading nameplate data, serial numbers, UL markings, and short circuit ratings
 - c) Installation procedures including splicing procedures
 - d) Conduit and cable installation
 - e) Installing and removing plug-in units
 - f) Operation of operator handles and unit interlocks
 - g) Checklist before energizing
 - h) Procedure for energizing equipment
 - i) Maintenance procedures

1.06 FINAL SUBMITTALS

- A. Refer to Section [xx xx xx] for the procedure on submittal of final documentation.
- B. The contractor shall provide certification that the MCC has been installed in accordance with the manufacturer's instructions and with local codes and standards that govern MCC installations.
- C. The contractor shall provide certification that all circuit breaker settings have been adjusted per field requirements.
- D. The contractor shall provide certification that all power fuses have been selected and installed per field requirements.
- E. The contractor shall provide certification that all solid-state motor overload settings have been adjusted per installed motor characteristics.
- F. The contractor shall provide certification that all settings for solid state devices such as reduced voltage solid-state controllers and variable frequency drives have been adjusted per the specific application requirements.
- G. The contractor shall provide certification that any timing devices have been properly adjusted.

H. As Shipped Drawings.

1. The manufacturer shall provide final drawings reflecting the 'As-Shipped' state of the MCC documents previously submitted
2. Manufacturer drawings shall be provided in PDF format
3. Manufacturer drawings do not need to be stamped if a drawing schedule is provided that lists the drawing numbers, version levels, and status of drawings (such as, Preliminary, Approval, Final)
4. The contractor shall be responsible for making any changes to the 'As-Shipped' drawings from the manufacturer to reflect any field modifications

I. Manufacturer's Operation and Maintenance Manuals.

1. As-Shipped Drawings
2. Certificate of Quality Conformance
3. Maintenance data
4. MCC installation instructions
5. Installation/operation instructions for major components such as, automatic transfer switch, and circuit breakers
6. MCC spare parts listing and pricing

1.07 QUALITY ASSURANCE

- A. The manufacturer of the MCC shall have a minimum of 45-years of experience in the manufacturing and assembly of NEMA Low Voltage motor control centers.
- B. The manufacturer shall have ISO 9001 registered facilities for the design, manufacture, and testing of MCCs.
- C. MCC sections and individual MCC units shall be designed and manufactured in accordance with UL 845 requirements.
- D. MCC sections and individual MCC units shall be UL listed, where possible.

1.08 REGULATORY REQUIREMENTS

- A. Contractor shall ensure that the installation conforms to the requirements of the latest edition of the NFPA 70 'National Electrical Code' and/or other applicable installation standards.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. The contractor shall coordinate the shipping splits with the MCC manufacturer for entry into the building.
- B. Shipping splits shall be noted on the MCC manufacturer drawings.
- C. The contractor shall store the MCCs in a clean, dry, and heated space.
- D. The contractor shall protect the units from dirt, water, construction debris, and traffic.
- E. During storage the contractor shall connect internal space heaters (if specified) with temporary power.
- F. MCCs are to be shipped with external lifting angles at the top and running continuously for each shipping split. Lifting eyelets are not acceptable.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. The MCC enclosure rating shall be appropriate for the environment where the MCC is to be located.

1.11 FIELD MEASUREMENTS

- A. The contractor shall verify all field measurements prior to the fabrication of the MCC.

1.12 WARRANTY

- A. The manufacturer shall provide their standard parts warranty for 12 months from the date of shipment from the manufacturer's factory.
- B. The manufacturer shall confirm this warranty as part of the submittal.

1.13 SPARE MATERIALS

- A. The contractor shall review the manufacturer's recommended spare parts list and discuss it with the owner to determine requirements for spare parts.
- B. The contractor is to provide the quotation for spare parts to the owner.

PART 2 Motor Control Center Specifications

2.01 MANUFACTURERS

- A. MCCs shall be Allen-Bradley® CENTERLINE® 2100 motor control centers.

2.02 RATINGS

- A. The MCC shall be rated for the system voltage as indicated on the contract drawings.
- B. The MCC horizontal and vertical power bus bracing shall be rated to meet or exceed the available fault current as shown on the contract drawings, but shall not be less than 42,000 A rms symmetrical.
- C. All MCC units shall have a full rated short-circuit rating that meets or exceeds the available fault current as shown on the contract drawings.
 - 1. The use of series short-circuit current ratings shall be permitted only for panelboards; series short-circuit ratings for other types of units is not acceptable
- D. All circuit breakers used in the motor control center shall have full-rated short-circuit current ratings based on the applied MCC voltage.
 - 1. Slash rated short-circuit interrupting ratings for circuit breakers are not acceptable except for branch circuit breakers in panelboards, and then only if the power system specified in the contract drawings is a Wye with a solidly grounded neutral

If an arc resistant MCC is required, include the following specification point.

- E. The MCC shall provide **[Type 2]** Accessibility as defined by IEEE C37.20.7 'IEEE Guide for Testing Metal-enclosed Switchgear Rated up to 38 kV for Internal Arcing Faults'.

2.03 ENCLOSURE

- A. The MCC enclosure shall be NEMA Type **[1]** **[1 with gasket around perimeter of doors]** **[12]** **[3R, non-walk-in]**.
- B. Each section shall be equipped with two full-metal side sheets to isolate each vertical section and to help reduce the likelihood of fault propagation between sections.
- C. All interior and exterior surfaces shall be painted ANSI 49 medium-light gray. The vertical wireways and unit back plates shall be painted high-visibility gloss white.
- D. All unpainted parts shall be plated for corrosion resistance.
- E. Removable closing plates on each end of the MCC shall cover all horizontal bus and horizontal wireway openings.

If an arc resistant MCC is required, include the following specification point.

- F. Insulating sheets shall be provided on the inside of end closing plates for horizontal bus openings to help prevent burn-through of the end closing plate in the event that an internal arcing fault occurs in the horizontal bus compartment.
- G. The enclosure shall provide Arc protection without the use of plenum on top of the structure.

2.04 STRUCTURE

- A. The MCC shall be of dead front construction and shall consist of one or more vertical sections bolted together to form a rigid, free-standing assembly. The systems shall be designed to allow for the addition of future sections at either end and to permit the interchanging of units.
 - B. Vertical sections shall be rigid, free-standing structures.
 - 1. Vertical sections shall have internal mounting angles running continuously within the shipping block
 - 2. An external mounting channel that is required to maintain structure integrity is not acceptable
 - 3. Vertical sections shall be 90 in. high, **[15]** or **[20]** in. deep and 20 in. Wide, except where larger dimensions are required
 - 4. 71 in. high, reduced height sections shall be provided, if specified on the contract drawings
 - 5. Vertical sections shall be provided with a removable steel lifting angle on all shipping blocks. The angle shall run the length of the shipping block
 - 6. Lifting eyes are not acceptable
 - 7. Each standard section shall be capable of being subdivided into 12 usable, unit spaces
 - 8. Two unit spaces shall constitute one space factor and shall be 13 in. in height
 - 9. One unit space shall constitute one-half space factor and shall be 6.5 in. in height
 - C. Horizontal wireways.
 - 1. Horizontal wireways shall be located at the top and bottom of the MCC
 - 2. Horizontal wireways shall be 6 in. in height and extend the full depth of the vertical section to allow maximum flexibility in locating conduit for MCC feeds and loads
 - a) Pull-boxes to extend the height of the top horizontal wireway by 12 in. shall be provided, if specified on the contract drawings
 - 3. Horizontal wireways shall be continuous across the length of the MCC, except where access needs to be denied due to electrical isolation requirements
 - 4. The horizontal wireways shall be isolated from the power bus
 - 5. The horizontal wireways shall have removable covers held in place by captive screws
 - D. Provide a full height vertical wireway, independent of the plug-in units, in each standard vertical section.
 - 1. The vertical wireway shall be isolated from the vertical and horizontal buses
 - 2. The vertical wireway shall be covered with a hinged and secured door
 - 3. Wireway tie bars shall be provided
 - 4. Isolation between the wireway and units shall be provided
 - 5. Vertical wireway doors shall be provided with arc resistant latches to help keep the door latched in the event that an internal arcing fault occurs
- If an arc resistant MCC is required, include the following specification point.

2.05 BUS BARS

A. Horizontal Power Bus.

1. The horizontal bus shall be rated as shown on the drawings
2. The horizontal bus material shall be copper with tin plating
3. The horizontal bus shall be supported, braced and isolated from the vertical bus with a high strength, non-conductive, non-tracking, glass polyester material
4. For standard sections, the horizontal bus shall be continuous within each shipping block and shall be braced within each section
5. Horizontal bus splices shall have at least two bolts on each side

If UL-Rated insulated bus is required, include the following specification point for 1600 A horizontal power bus and lower.

6. The horizontal bus shall be insulated by using a polypropylene flame-retardant wrap

B. Vertical Bus.

1. The vertical power bus shall have an effective rating of 600 A. If a center horizontal bus construction is utilized, then the rating shall be 300 A above and below the horizontal bus for an effective rating of 600 A. If a top or bottom mounted horizontal bus is utilized, then the full bus must be rated for 600 A
2. The vertical bus material shall be copper with tin plating
3. The vertical bus shall attach to the horizontal bus with at least two bolts
4. The vertical bus shall be continuously braced by a high strength, non-conductive, non-tracking, glass-filled polyester material and isolated from the unit spaces by a non-conductive, polycarbonate molded cover
5. The vertical bus shall be isolated from the horizontal power bus except where necessary to connect the vertical power bus to the horizontal power bus
6. Automatic shutters shall cover plug-in stab openings when units are removed

C. Ground Bus.

1. Provide a ground bus system consisting of a horizontal ground bus connected to vertical ground buses mounted in each section
2. Provide an **[unplated] [tin-plated]** copper **[0.25 x 1 in] [0.25 x 2 in.]** horizontal ground bus mounted in the bottom of the MCC unless otherwise specified in the drawings
3. Provide a pressure-type mechanical lug mounted on the ground bus in the incoming line section
4. Provide a unit ground stab on all unit inserts. The ground stab shall establish unit insert grounding to the vertical ground bus before the plug-in power stabs engage the power bus. The grounding shall be maintained until after the plug-in power stabs are disengaged

The following two specification points are required only if a unit load ground bus is required. The vertical load ground bus provides a means to terminate incoming unit ground cables at the unit. This avoids wastage associated with power conductors when using multi-conductor cable when only a horizontal ground bus is provided, because extra cable must be pulled in order to be able to connect the ground conductor to the horizontal ground bus.

Delete if a unit load ground bus is not required.

5. Provide a copper vertical-unit load ground bus in each section that can accommodate plug-in units

6. Provide a unit load connector on all units that require load wire connections. The load connector shall provide a termination point for the load ground conductor at the unit

D. Neutral Bus.

1. In a 4-wire system with a main incoming device rated 400 A or less, if there are no neutral loads in the MCC, an incoming neutral termination plate in the MCC main device unit is acceptable in lieu of a horizontal neutral bus
2. In a 4-wire system with a main incoming device rated more than 400 A, if there are no neutral loads in the MCC, an incoming neutral termination plate in the MCC main device unit that is connected to horizontal neutral bus in the section with the main is acceptable
3. If neutral loads are specified within the MCC, provide neutral connection plates in sections with horizontal neutral bus as indicated on the contract drawings
4. Horizontal neutral bus shall be provided in **[main incoming section only] [main incoming and adjacent sections as specified on the contract drawings] [all sections]**
5. Neutral bus rating shall be **[same as] [half of]** the horizontal power bus rating
6. For neutral loads that are served, Vertical neutral bus in 9 in. wireway shall be provided in sections with plug-in units as defined on the contract drawings

Choose only one type of communication network **[EtherNet/IP – Section 2.06] [DeviceNet – Section 2.07]** for the MCC application, as they are mutually exclusive.

2.06 ETHERNET/IP COMMUNICATION

A. The MCC shall have Ethernet wiring incorporated into its design.

1. The MCC shall have factory installed industrial Ethernet cabling incorporated throughout the vertical section across the entire lineup
2. Each motor starter, electronic overload relay, power monitor, AC drive, and soft starter unit in the MCC shall be supplied with a means to communicate via EtherNet/IP network
3. Plug-in units should be able to move around without impacting the network
4. Maintenance activities should be able to be performed without impacting the network

B. Industrial Ethernet Switch.

1. The MCC shall have managed industrial Ethernet switch(s) with Ports to connect each EtherNet/IP enabled device
2. Ethernet Switches shall be provided with spare ports to accommodate network expansion and future plug-in unit inserts
3. The managed industrial Ethernet switch shall deliver optimal network security, network resiliency (if needed), and flexibility. The functionality should include port based control/prioritization, switch-level ring support, VLAN segmentation, and other Layer-2 switch features
4. The managed industrial Ethernet switch shall have the ability to include, if needed, Gigabit ports, CIP Sync functionality, Network Address Translation (NAT), and an Industrial SD Card
5. The managed industrial Ethernet switch shall include redundant terminal blocks for customer supplied/connection of an external 24V DC UPS

Choose only one type of Ethernet Switch layout **[Section 1 – Fixed-Mount Switch Unit]** **[Section 2 – Horizontal Wireway Mounted Ethernet Switch]** for the MCC application, as they are mutually exclusive.

C. Industrial Ethernet Switch Layout.

1. Layout – Fixed-Mount Switch Unit

- a) The managed industrial Ethernet Switch shall be mounted in a fixed-mount, Switch Unit in the **[top]** **[bottom]** of the section
- b) The industrial Ethernet cable shall connect each switch to one another in a **[linear]** **[ring]** topology
- c) The Switch Unit shall be provided with a locking latch
- d) The Switch Unit shall be provided with a door mounted viewing window
- e) The Switch Unit shall be provided with a door mounted external network connector

2. Layout – Horizontal Wireway Mounted Ethernet Switch

- a) The managed industrial Ethernet Switch shall be mounted in the **[top]** **[bottom]** horizontal wireway
- b) The industrial Ethernet cable shall connect each switch to one another in a **[linear]** **[ring]** topology

D. Industrial Ethernet Cabling.

1. Industrial Ethernet Cable Ratings

- a) The industrial Ethernet cable shall be 600V UL Category 5e PLTC rated
- b) The use of a 300V rated cable is not acceptable
- c) Ethernet Switch-to-Device cable labels shall be located on both ends of the cable to specify where the cable is connected to on both ends
- d) A detailed Ethernet network table and Ethernet network diagram specifying IP addresses, subnet masks, device locations, cable label details, and 24V DC capacities shall be included in the MCC documentation

Choose only one type of Ethernet Cable layout **[Section 2 – Homerun Ethernet Connections]** **[Section 3 – Vertical Wireway Ethernet Adapters/Ports]** for the MCC application, as they are mutually exclusive.

2. Layout – Homerun (direct switch-to-device) Ethernet Connections

- a) An industrial Ethernet cable shall be routed from the managed industrial Ethernet Switch directly to the EtherNet/IP device in each unit
 - i. The industrial Ethernet cable shall be routed through the top or bottom horizontal wireway and transition through the vertical wireway directly to the EtherNet/IP device
 - ii. The industrial Ethernet cable shall be secured to vertical wireway tie bars
- b) The EtherNet/IP device within each unit shall be factory connected to the industrial Ethernet switch directly by using a 600V – UL rated Category 5e PLTC rated industrial Ethernet cable

3. Layout – Vertical Wireway Ethernet Adapters/Ports.
 - a) An industrial Ethernet cable shall be routed behind the vertical wireway from the managed industrial Ethernet Switch to the Ethernet adapters located in the vertical wireway
 - b) A second industrial Ethernet cable shall be routed from the EtherNet/IP device within each unit and factory connected to the Ethernet adapter ports in the vertical wireway by using a 600V – UL rated Category 5e PLTC rated industrial Ethernet cable
 - c) Up to four (4) Ethernet adapters allowing up to eight (8) Ethernet device connections that meet the following criteria shall be provided:
 - i. In necessary vertical wireways of standard sections to simplify installation, relocation and addition of plug-in units
 - ii. Each Ethernet adapter in the vertical wireway shall be connected to a port on the industrial Ethernet switch by using a 600V – UL rated Category 5e PLTC rated industrial Ethernet cable
 - d) The industrial Ethernet cable for Frame Mounted units shall be routed through the horizontal wireway from the managed industrial Ethernet Switch directly to the EtherNet/IP Frame Mounted device using a 600V – UL rated Category 5e PLTC rated industrial Ethernet cable
4. Power Supplies.
 - a) Power supplies shall provide 24V DC for the devices that require it
 - b) The MCC manufacturer shall check the user's design to confirm that adequate power supplies have been specified to conform with network requirements
 - c) Power supply output shall be rated 8 A, 24V DC
 - d) Power supplies shall be Allen-Bradley Bulletin 1606-XLS240E or approved equal
 - e) Power supply units shall be provided with a buffer module to provide a minimum of 500 ms ride-through at full load (the buffer module is optional for the standard Ethernet power supply)
 - f) Buffer modules shall be Allen-Bradley Bulletin 1606-XLSBUFFER24 or approved equal
 - g) Two (2) 24V DC adapters allowing four (4) power connections **[shall] [shall not]** be provided:
 - i. In each vertical wireway of standard sections to simplify installation, relocation and addition of plug-in units
 - ii. Each 24V DC adapter in the vertical wireway shall be connected to the power supply
 - h) The power supplies units shall be provided with a door mounted external 120V AC connection for laptop power and Ethernet network connection

- i) Redundant 24V DC power shall be provided for all Ethernet enabled devices. Choose one type of 24V DC redundancy for the MCC application as they are mutually exclusive:
 - i. A Redundancy Unit shall be included that provides the capability of interconnecting two independent power supplies in a redundant way (N+1) and whose output is connected to the 24V DC circuit. The Redundancy Unit shall be powered by one of the following options:
 - a. Two Rockwell Automation-supplied 24V DC power supply units
 - b. One Rockwell Automation-supplied 24V DC power supply unit and one external power input provided by the customer
 - c. Two external 24V DC power inputs provided by the customer
 - ii. Two 8 A power supply modules shall be placed in the same power supply unit and wired in parallel with blocking diodes whose output is connected to the 24V DC circuit

E. EtherNet/IP Interface for Motor Starter Units.

- 1. Motor starter units shall have an electronic overload relay that incorporates the following features:
 - a) Built-in EtherNet/IP communication
 - b) Overload relay I/O powered by using **[24V DC] [120V AC]**
 - c) Status indicators for status indication
 - d) Overload relays shall have a reset button on the outside of the unit door
 - e) Selectable trip of NEMA Class 5 to 30. Unless indicated, the trip class shall be set for NEMA Class 20 operation
 - f) Up to six (6) inputs and three (3) outputs of direct I/O. Additional I/O can be provided with an add-on module to the overload relay. Input voltage shall match the overload relay power voltage
 - g) Protective functions
 - i. Functions shall provide a programmable trip level, warning level, time delay, and inhibit window
 - ii. Protective functions shall include Thermal overload, Phase loss, Stall, Jam, Underload, Current imbalance, Remote trip, and PTC thermistor input
 - iii. Ground fault protection **[is] [is not]** required
 - a. If ground fault protection is required, the protection range shall be **[500 mA to 5 A] [20 mA to 5 A]**
 - iv. PTC Thermistor input **[is] [is not]** required
 - v. Voltage protection **[is] [is not]** required
 - a. Input fusing shall not be used on NEMA 3 and smaller starters
 - h) Current monitoring functions shall include phase current, average current, full load current, current imbalance percent, percent thermal capacity utilized, and ground fault current (if required)
 - i) Voltage, energy, and frequency measuring capabilities shall be included when voltage protection is required

- j) Diagnostic information shall include device status, warning status, time to reset, trip status, time to overload trip, and history of last five trips
 - k) Preventive maintenance information shall include Allowable starts per hour, required Time between starts, Starts counter, Starts available, Time until next start, total operating hours, and elapsed operating time
 - l) Overload relay shall include an on-board logic processor to allow basic logic to be performed within the overload relay based on network data and the status of the inputs to the overload relay
 - m) The overload relay shall support the following CIP messaging types: Polled I/O messaging, Change-of-state/cyclic messaging, Explicit messaging, Group 4 offline node recovery messaging, and Unconnected Message Manager (UCMM)
 - n) The overload relay shall provide the following functions to minimize network configuration time: Full parameter object support, Configuration consistency value, and Add-on Profile
 - o) The overload relay shall include a **[E300 Control Station] [E300 Diagnostic Station]** connected to the overload relay by a single cable
2. The overload relay shall be Allen-Bradley 193-ESM/592-ESM, 193-EIO/592-EIO, or 193-ECM 'E300' Electronic Overload or approved equal
- F. EtherNet/IP Interface for Variable Frequency AC Drives and Solid-State Reduced Voltage Motor Controllers.
- 1. The EtherNet/IP communication interface shall be supplied to allow for communication between the solid-state component and the Ethernet network
- G. EtherNet/IP Interface for Other Units.
- 1. Provide an EtherNet/IP interface for other units as indicated on the contract drawings
 - 2. Refer to the contract drawing wiring diagrams for points to be monitored
- H. Programming and Testing.
- 1. The MCC manufacturer shall load the IP Address and Subnet Mask into each unit and Ethernet switch
 - 2. The IP Address shall be as indicated on the contract drawings or as provided by the contractor
 - 3. The MCC manufacturer shall test the MCC to ensure that each unit communicates properly prior to shipment
 - 4. The MCC manufacturer shall provide a disk containing applicable electronic data sheet (EDS) files for the EtherNet/IP devices
 - 5. The IP Address **[shall] [shall not]** be visible on the unit Nameplate for any units containing an EtherNet/IP enabled device
 - 6. All firmware will be provided with the same revision level of firmware across all similar intelligent electronic devices
 - a) E300 overload relays
 - b) PowerFlex® 523, PowerFlex 525 drives
 - c) PowerFlex 753, PowerFlex 755 drives
 - d) Stratix® 5700 switches

- e) PowerMonitor™ 5000 energy meters
- f) SMC™ Flex starters

Choose only one type communication network **[EtherNet/IP – Section 2.06]** **[DeviceNet – Section 2.07]** for the MCC application, as they are mutually exclusive.

2.07 DEVICENET COMMUNICATION

A. The MCC shall have DeviceNet wiring incorporated into its design.

- 1. The MCC shall have DeviceNet cabling incorporated throughout the vertical section
- 2. Each motor starter, AC drive, and soft starter unit in the MCC shall be supplied with a means to communicate via the DeviceNet network

B. DeviceNet Cabling.

1. DeviceNet Cable Ratings

- a) The DeviceNet cable shall be in compliance with Article 300.3(C)(1) of the National Electrical Code
- b) The insulating rating shall be equal to at least the maximum circuit voltage applied to any conductor within the enclosure or raceway
- c) No special separation, barriers, or internal conduit shall be required for the DeviceNet conductors
- d) The trunk line cable shall be flat cable rated 8 A, 600V, Class I
- e) The drop cable used to connect a unit to a DeviceNet port in the vertical wireway shall be round cable rated 8 A, 600V, Class I
- f) The use of a Class II network is not acceptable

2. Layout

- a) A DeviceNet trunk line shall be routed through the MCC lineup. To prevent accidental mechanical damage during MCC installation, the trunk line shall be located behind barriers to isolate the trunk line from the unit space and wireways
- b) Six DeviceNet ports shall be provided in the rear of each vertical wireway of standard sections to simplify installation, relocation, and addition of plug-in units
- c) Dual port connectors shall be provided when more than six DeviceNet unit connections are required in an MCC section
- d) The DeviceNet device within each unit shall be factory connected to a DeviceNet port

3. Power Supplies

- a) Power supplies shall be ODVA approved for the DeviceNet network
- b) The power supply shall provide 24V DC for the DeviceNet system and shall be rated no less than 8 A
- c) Power supplies for the MCC DeviceNet system shall be supplied as a separate plug-in units
- d) The MCC manufacturer shall check the user's design to ensure that adequate power supplies have been specified to conform with DeviceNet requirements

- e) Power supply output shall be rated 8 A, 24V DC
- f) Power supplies shall be Allen-Bradley catalog number 1606-XLS240E or approved equal
- g) Power supplies unit shall be provided with a buffer module to provide a minimum of 500 ms ride-through at full load
- h) The buffer modules shall be Allen-Bradley catalog number 1606-XLSBUFFER24 or approved equal

C. DeviceNet Interface for Motor Starter Units.

1. Motor starter units shall have an electronic overload relay that incorporates the following features:
 - a) Built-in DeviceNet communication
 - b) LEDs for status indication
 - c) Test/Reset button
 - d) Selectable trip of NEMA Class 5 to 30. Unless indicated, the trip class shall be set for NEMA Class 20 operation
 - e) Four inputs and two outputs. Refer to the contract drawings for connection requirements
 - f) Protective functions
 - i. Functions shall provide a programmable trip level, warning level, time delay, and inhibit window
 - ii. Protective functions shall include Thermal overload, Phase loss, Stall, Jam, Underload, Current imbalance, Remote trip, and PTC thermistor input
 - iii. Ground fault protection **[is] [is not]** required
 - a. If ground fault protection is required, protection range shall be 0.5 A to 5 A for NEMA Size 3 and smaller starters, and 20 mA to 5 A for NEMA Size 4 and larger starters
 - g) Current monitoring functions shall include phase current, average current, full load current, current imbalance percent, percent thermal capacity utilized, and ground fault current (if required)
 - h) Voltage, energy, and frequency measuring capabilities shall be included
 - i) Diagnostic information shall include device status, warning status, time to reset, trip status, time to overload trip, and history of last five trips
 - j) Preventative maintenance information shall include Allowable starts per hour, required Time between starts, Starts counter, Starts available, Time until next start, total operating hours, and elapsed operating time
 - k) Overload relay shall include an on-board logic processor to allow basic logic to be performed within the overload relay based on network data and the status of the inputs to the overload relay
 - l) The overload relay shall support the following DeviceNet messaging types: Polled I/O messaging, Change-of-state/cyclic messaging, Explicit messaging, Group 4 off-line node recovery messaging, and Unconnected Message Manager (UCMM)
 - m) The overload relay shall provide the following functions to minimize network configuration time: Full parameter object support, Auto-baud rate identification, Configuration consistency value, and Automatic Device Replacement (ADR)

2. The overload relay shall be Allen-Bradley 193-ESM/592-ESM, 193-EIO/592-EIO, or 193-ECM 'E300' Electronic Overload or approved equal
- D. DeviceNet Interface for Variable Frequency AC Drives and Solid-state Reduced Voltage Motor Controllers.
1. The DeviceNet communication interface shall be supplied to allow for communication between the solid-state component and the DeviceNet system
- E. DeviceNet Interface for Other Units.
1. Provide a DeviceNet interface for other units as indicated on the contract drawings
 2. The DeviceNet interface shall have four inputs and two outputs
 3. Refer to the contract drawing wiring diagrams for points to be monitored
 4. The DeviceNet interface shall include an on-board logic processor to allow basic logic to be performed within the interface based on network data and the status of the inputs to the overload relay
 5. The DeviceNet interface shall be Allen-Bradley Bulletin 100-DNY 'DeviceNet Starter Auxiliary (DSA) Module' or approved equal
- F. Programming and Testing.
1. MCC manufacturer shall load the DeviceNet MAC ID number (node address) into each unit
 2. DeviceNet MAC ID number shall be as indicated on the contract drawings or as provided by the contractor
 3. DeviceNet network shall be designed and programmed for use at 250 kB or 500 kB Baud rate
 4. MCC manufacturer shall test the MCC to ensure that each unit communicates properly prior to shipment
 5. Each DeviceNet device shall have a label showing the unit location, node address, and communication rate
 6. MCC manufacturer shall provide a disk containing applicable electronic data sheet (EDS) files for the DeviceNet devices

2.08 UNIT INFORMATION

- A. The minimum compartment height shall be 6.5 in. and this shall be considered one-half space factor.
- B. NEMA Size 5 FVNR starters and below shall be provided as plug-in units.
- C. Plug-in units.
 1. Plug-in units shall consist of a unit assembly, unit support pan, and unit door assembly
 2. Units shall be supplied with removable doors. The unit doors shall be fastened to the structure so that the doors can be closed when the unit is removed
 3. A unit support pan shall be provided for support and guiding units. Unit support pans shall remain in the structure when units are removed to provide isolation between units. A service position shall be provided for plug-in units that allows for the unit to be supported, but disengaged from the bus. The unit shall be capable of being padlocked in the service position. This position is to be used to isolate a unit from the bus to allow service to be performed on the connected load equipment

D. Power Stabs.

1. Unit stabs for engaging the power bus shall be tin-plated copper and provided with stainless back-up springs to provide and maintain a high-pressure, 4-point connection to the vertical bus
2. Wiring from the unit disconnecting means to the plug-in stabs shall not be exposed on the rear of the unit. A separate isolated pathway shall be provided for each phase to minimize the possibility of unit fault conditions reaching the power bus system
3. Power cable termination at the plug-in stab shall be a maintenance-free crimp type connection

If SecureConnect™ is required, include the following specification point.

E. Withdrawable Power Stabs.

1. Plug-in units shall have the capacity of withdrawing the power stabs, allowing the primary voltage to be disconnected with the unit door closed
2. The withdrawable assembly shall accept a standard 1/4' hex-style drive socket
 - a) A complete power engagement shall occur when turning the mechanism ¼ turn in clockwise direction
 - b) Complete power disengagement shall occur when turning the mechanism ¼ turn in counter-clockwise direction
3. The withdrawable stabs design shall include a set of stab assembly-mounted shutters
 - a) Shutters shall automatically open before the power stabs can extend and connect to the vertical bus
 - b) Shutters shall close as soon as the power stabs are disconnected from the vertical bus and are completely inside the stab housing
4. The withdrawable stabs design shall include interlock mechanisms
 - a) A through-the-door mechanism shall allow the unit to be locked in the 'Power Stabs Disconnected' position
 - i. This mechanism shall be such that it can be padlocked to prevent the connection of the stabs to the vertical bus even when the unit is inserted into the vertical section
 - ii. Unit door shall be capable of opening with the padlock and lockout engaged
 - b) Unit disconnect handle must be in the OFF position (load side of the disconnect device removed from line power) before the stabs can be disconnected from the vertical bus
 - i. Mechanism shall also allow the removal of the unit from the vertical section but only after the disconnect handle has been turned OFF and the power stabs have been disconnected from the vertical bus
 - ii. Unit stabs have to be disconnected (withdrawn) before the unit can be re-inserted into the vertical section

5. The withdrawable stabs design shall include feedback mechanisms that are verifiable with the unit door closed
 - a) A two-position indication system shall be provided (Power Stabs Connected/Disconnected) and shall be visible from the door
 - i. Connected with Red Indication—Primary voltage stabs fully engaged and connected to the vertical bus
 - ii. Disconnected with Green Indication—Primary voltage stabs fully disconnected from the vertical bus
 - b) A set of test points shall be located on the front of the unit for identification of:
 - i. Power stabs position: a positive continuity check between these probes shall verify that all three power stabs have been disconnected from the vertical bus and completely withdrawn inside the stabs housing
 - ii. Stab-mounted shutters position: a positive continuity check between these probes shall verify that the shutters are closed, meaning that all three power stabs have been disconnected and withdrawn inside the stab housing
 6. Withdrawable power stabs with door closed mechanism shall not increase the original unit height design so total space in the motor control center is optimized
- If CBS Arcsafe Secure Connect Remote operator is required, add the following specification point.
7. A remote operating device shall be supplied to allow the connection and disconnection of the power stabs with the door closed
 - a) The minimum distance shall be not less than three times the minimum default value recommended by the NFPA 70E (Arc Flash Protection Boundary—Annex D)
- F. Disconnect Handle.
1. Plug-in units shall be provided with a heavy-duty, non-conductive, industrial duty, flange mounted handle mechanism for control of each disconnect switch or circuit breaker
 2. Use of rotary operators is not acceptable
 3. Disconnect handles may pivot in the vertical or horizontal plane
 4. On-off condition shall be indicated by the handle position, red and green color indicators with the words ON and OFF, and the international symbols 1 and O along with a pictorial indication of the handle position
 5. Handles shall be capable of being locked in the OFF position with up to three padlocks
 6. Plug-in units shall be provided with interlocks per NEMA and UL requirements
Interlocks shall be provided for the following:
 - a) Prevention of unit insertion or withdrawal with the disconnect in the ON position
 - b) Prevention of the unit door from being opened when the disconnect is in the ON position
 - i. A feature for intentionally defeating this interlock by qualified personnel shall be provided

- c) Prevention of the disconnect switch from being moved to the ON position if the unit door is open
 - i. A feature for intentionally defeating this interlock by qualified personnel shall be provided

G. Pilot Devices.

- 1. Where specified, units shall be furnished with pushbuttons, selector switches, or pilot lights as shown on the contract drawings
- 2. Pilot devices shall be rated NEMA Type 4/13 water tight/oil tight
- 3. For units with vertically operated disconnect handles:
 - a) When three or less pilot devices are utilized, they shall be Allen-Bradley Bulletin 800H 30.5mm devices or approved equal
 - b) When more than three devices are required, the use of Allen-Bradley Bulletin 800F 22.5mm devices (or approved equal) is permitted
 - c) For Drives pilot devices:
 - i. 800H 30.5 mm devices or approved equal will be provided for all PowerFlex 70 drives
 - ii. 800F 22.5 mm devices or approved equal will be provided for all PowerFlex 750 and PowerFlex 520 series drives
- 4. For units with horizontally operated disconnect handles:
 - a) The devices shall be Allen-Bradley Bulletin 800F

H. Terminal Blocks.

- 1. Control terminal blocks shall be provided on all contactor and starter units.
 - a) Control terminal blocks shall be a pull-apart design on all plug-in units for easy removal of the unit from the structure
- 2. Control terminal blocks on non-plug-in contactor and starter units shall be fixed type
- 3. Power terminal blocks shall be provided on all contactor and starter units, rated NEMA size 3 (100 A) and below that utilize vertically operated disconnects
 - a) Power terminal blocks shall be pull-apart for NEMA size 1 and 2 (30 A and 60 A contactors)
 - b) Power terminal blocks for NEMA size 3 starters (100 A contactors) shall be non-pull-apart
- 4. Terminal blocks shall not be located adjacent to or inside the vertical wireway

I. Doors.

1. Each unit shall be provided with a removable door mounted on removable pin-type hinges
2. The unit doors shall be capable of being opened at least 110 degrees
3. The unit doors shall be removable from any location in the MCC without disturbing any other unit doors
4. The unit door shall be fastened to the structure so it can be closed to cover the unit space when the unit is removed
5. The unit doors shall be held closed with quarter-turn latches

If an arc resistant MCC is required, include the following specification point.

6. Unit door latches shall be provided with arc resistant latches to help keep the door latched in the event that an internal arcing fault occurs

2.09 METERING COMPARTMENT

- A. MCCs shall include a plug-in metering unit.
B. Units shall include the following:

1. Fusible disconnect with fuses
 - a) The disconnect must be operable with the unit door closed
2. Fused control circuit transformer
3. Current transformers shipped loose to be installed by the contractor onto incoming power conductors
4. Solid-state power monitor with door mounted display

C. Power Monitor.

1. Power monitors shall be capable of displaying the following:
 - a) Line current for all three phases with plus or minus 0.2 percent full-scale accuracy
 - b) Average three phase current with plus or minus 0.2 percent full-scale accuracy
 - c) Line-to-neutral and line-to-line voltage with plus or minus 0.2 percent of full-scale accuracy
 - d) Current and voltage unbalance
 - e) Real, reactive, apparent, and true power with plus or minus 0.4 percent full-scale accuracy
 - f) KWh, KVARh, and kVAHnet
 - g) True RMS to the 45th harmonic
 - h) Frequency at plus or minus 0.5%
 - i) Power factor at plus or minus 0.4%
2. Power monitors shall include min/max logs and trend logs with up to 45,867 data points
3. Power monitors shall be capable of performing distortion analysis with THD, Crest Factor (I, V) and Distortion power factor
4. The power monitor shall include **[EtherNet/IP] [DeviceNet]** communication module
5. Power monitors shall include two form-C relays
6. Power monitors shall be Allen-Bradley PowerMonitor 5000 unit or approved equal

2.10 DISCONNECTS

A. Main Disconnect.

1. If no overcurrent protection is indicated, provide a main incoming-line lug compartment
 - a) Lugs to accommodate the incoming power conductors as indicated on the contract drawings shall be provided by **[contractor] [MCC Manufacturer]**
2. Main Fusible Disconnect Switch (if specified in contract drawings)
 - a) Lugs to accommodate the incoming power conductors as indicated on the contract drawings shall be provided by the MCC manufacturer
 - b) Power fuses to be provided by **[contractor] [MCC manufacturer]**
 - c) Size fuses as shown on the drawings. Provide **[Class J] [Class R]** fuses through 600 A. Provide Class L fuses above 600 A
 - d) Provide a removable protective barrier to reduce the possibility of contact with the line terminals
 - e) Provide one normally open and one normally closed auxiliary contact
3. Main Circuit Breaker Disconnect (if specified in contract drawings)
 - a) Lugs to accommodate the incoming power conductors as indicated on the contract drawings shall be provided by the MCC manufacturer
 - b) Size the circuit breaker frame and trip rating as shown on the drawings
 - c) The interrupting capacity rating shall meet or exceed the available fault current as shown on the contract drawings
 - i. Interrupting capacity based on a slash rating is not acceptable
 - d) Provide a circuit breaker with thermal magnetic trip unit for 250 A and smaller frames; provide electronic trip unit for 400 A and larger frames
 - e) Provide a removable protective barrier to reduce the possibility of incidental contact with the line terminals
 - f) Provide one normally open and one normally closed circuit breaker auxiliary contact that follows the position of the circuit breaker main contacts for indication of 'On' or 'Off/Tripped'
 - g) For circuit breakers rated 1000 A and above, on Wye connected systems with a solidly grounded neutral, provide integrated ground fault protection with adjustable pick-up and adjustable time delay

B. Feeder Disconnects

1. Disconnecting means for feeders shall be circuit breakers with thermal-magnetic trip units for 250 A and smaller frames; provide an electronic trip unit for 400 A and larger frames
2. Interrupting capacity rating shall meet or exceed the available fault current as shown on the contract drawings
 - a) Interrupting capacity based on a slash rating is not acceptable
3. Minimum frame size shall be 125 A

4. Provide one normally open and one normally closed circuit breaker auxiliary contact which follows the position of the circuit breaker main contacts for indication of 'On' or 'Off/Tripped'

2.11 AUTOMATIC TRANSFER SWITCH

- A. Provide an automatic transfer switch if indicated on the contract drawings.
- B. Provide the automatic transfer switch in compliance with the automatic transfer switch specification. Refer to section 26 36 00.
- C. The automatic transfer switch shall be provided integral to the MCC and connected as indicated on the contract drawings.

2.12 COMBINATION NEMA ACROSS THE LINE STARTERS

- A. Starters shall meet applicable NEMA and UL requirements.
- B. Starters shall be minimum NEMA Size 1.
 1. Fractional NEMA sizes are not acceptable
- C. The motor starter shall be Allen-Bradley Bulletin 500 or 300 or approved equal.
- D. Starters shall be provided with a 3-pole solid state overload relay that includes the following features:
 1. If EtherNet/IP communication is required, refer to the part of this section titled 'EtherNet/IP Interface for Motor Starter Units', which takes precedence over this overload relay requirement
 2. If DeviceNet communication is required, refer to the part of this section titled 'DeviceNet Interface for Motor Starter Units', which takes precedence over this overload relay requirement
 3. Selectable trip classes of **[10, 15, 20, or 30 for E100 overloads] [5, 10, 15, 20, or 30 for E300 overloads]**
 4. Set for class 20 unless otherwise indicated on the contract drawings
 5. Overload protection
 6. Phase loss protection
 7. Trip current adjustment range of 5:1
 8. Visual trip status indication
 9. Test/Reset button
 10. Bipolar latching relay with one normally open and one normally closed contact, rated NEMA B600 for use in motor contactor control circuits
 11. Thermal memory circuit to model the heating and cooling effects of motor on and off periods
 12. **[Ground Fault] [Ground Fault and Jam] [no additional]** protection shall be provided
 13. If ground fault protection is required, it shall have a selectable trip value between 20 mA and 5 A
 14. The overload relay shall be Allen-Bradley **[E100] [E300]** Electronic Overload
- E. In addition to the hold-in contact, starters shall be provided with **[one normally open and one normally closed auxiliary contact] [auxiliary contacts shown on the contract drawing wiring diagrams]**. The starter shall be capable of accommodating up to six contact in addition to the hold-in contact.

- F. Provide a control power transformer with a rated secondary voltage of 120V AC. The control power transformer shall be provided with primary and secondary fusing.
- G. Overload relays shall have a reset button located on the outside of the unit door.
- H. Provide a door mounted selector switch for Hand-Off-Auto operation. The Hand mode shall provide local control at the MCC unit door. In the Auto mode, control shall be provided through a remote contact.
- I. Provide door mounted **[120V AC push-to-test pilot lights]** **[[120V AC non-push-to-test pilot lights]** **[E300 Control Station]** **[E300 Diagnostic Station]** with **[LED]** lamps for On **[Red]** and Off **[Green]** status indication.

2.13 MOTOR STARTER UNITS.

- A. Electro-mechanical NEMA starters:
 - 1. Disconnecting means for the across the line starters shall be motor circuit protectors
 - 2. Unit short-circuit current rating shall be greater than or equal to the available fault current as shown on the contract drawings
 - 3. Units shall be supplied based upon the rules/requirements set forth in the UL 845, NEMA ICS-18, and NFPA 70
 - 4. Contractor shall field adjust the units based upon the particular motor application.
 - 5. Minimum MCP frame size shall be 125 A
 - 6. Provide one normally open and one normally closed circuit breaker auxiliary contact that follows the position of the circuit breaker main contacts for indication of 'On' or 'Off/Tripped'

2.14 COMBINATION SOFT STARTER UNITS

- A. Disconnecting means for solid-state controllers shall be a **[Fusible Disconnect]** **[Inverse Time Circuit Breaker]**
- B. Unit short-circuit current rating shall be greater than or equal to the available fault current as shown on the contract drawings
- C. Provide a control power transformer with a rated secondary voltage of 120V AC. The control power transformer shall be provided with primary and secondary fusing.

Choose one of the following two paragraphs depending on the type of SSRV required.

- D. The controller shall be Allen-Bradley SMC Flex and shall include the following features:
 - 1. Integrated bypass contactor that is closed once the motor is up to full speed
 - 2. Electronic overload protection with adjustable trip class
 - 3. Four programmable auxiliary contacts
 - 4. Selectable control capabilities: soft start, kickstart, current limit start, dual ramp, full voltage, linear speed, preset slow speed, soft stop
 - 5. Additional control capabilities: **[Pump Control]** **[Braking control selectable - SMB™ Smart Motor Braking, Accu-Stop™, Slow Speed with Braking]** **[none required]**
 - 6. LCD display
 - 7. Keypad programming for configuration
 - 8. Built-in, selectable protective functions for: overload, jam, stall, excessive starts per hour, underload, over/under voltage, voltage unbalance

9. Metering capabilities for: current, voltage, kW, kWh, power factor, motor thermal capacity utilized, elapsed time
 10. Ground fault protection (1 A to 5 A) **[required]** **[not required]**
- E. The controller shall be Allen-Bradley SMC-3 and shall include the following features:
1. Integrated bypass contactor that is closed once the motor is up to full speed
 2. Electronic overload protection with adjustable trip class
 3. Selectable control capabilities: soft start, kickstart, current limit start, soft stop
 4. Built-in, selectable protective functions for: Overload, Phase Reversal, Phase Loss/Open Load, Phase Imbalance, Shorted SCR, SCR Over temperature
- F. Provide an input isolation contactor.
- G. The SMC unit shall be provided with line side protective modules. The modules shall contain capacitors and metal oxide varistors (MOVs) that protect the internal power circuitry from severe electrical transients and/or high electrical noise.
- H. Provide door-mounted pilot devices as shown on the contract drawing wiring diagrams.
- I. Provide door-mounted 120V AC **[push-to-test]** **[non-push-to-test]** pilot lights with **[LED]** lamps for On **[Red]** and Off **[Green]** status indication.
- J. Emergency run bypass contactor **[is]** **[is not]** required.
1. If required, emergency run bypass shall be fully rated for the motor load and be capable of starting the motor at full voltage. The emergency run bypass shall be provided with the same type of solid-state overload relay protection as for the electromechanical starter units

2.15 VARIABLE FREQUENCY DRIVES

- A. Variable frequency drives shall be Allen-Bradley PowerFlex 70, PowerFlex 523, PowerFlex 525, PowerFlex 753, PowerFlex 755 drives PowerFlex 755TL or PowerFlex 755TR drives.
1. Refer to section 26 29 23 for specifications
- B. Provide a control power transformer with a rated secondary voltage of 120V AC. The control power transformer shall be provided with primary and secondary fusing.
- C. Provide door-mounted pilot devices per the contract drawing wiring diagrams.
- D. Provide door-mounted 120V AC **[push-to-test]** **[non-push-to-test]** pilot lights with **[LED]** lamps for On **[Red]** and At-Speed **[White]** status indication.
- E. Provide a door-mounted human interface module for programming, display and control.
- F. Provide one isolated, configurable analog input and output.
- G. Provide an integrated network safety safe-torque-off capable of EtherNet/IP control.
- H. Harmonic mitigation, including the Point of Common Coupling (PCC), shall be as indicated on the drawings. MCC-mounted harmonic mitigation elements shall be UL/cUL listed.

- I. MCC-mounted Active Harmonic Filters (AHF), as indicated on drawings, shall be furnished for harmonic mitigation of the MCC-connected loads
 1. Limit harmonic current to <5% Total Demand Distortion (TDD) per IEEE519-1992, table 10.3
 2. AHFs shall be capable of parallel connection of multiple units to meet the required level of mitigation
 3. Door-interlocked disconnect shall be furnished
 4. Shall include electronic output current limiting and over-temperature protection
 5. Current Transformers (CTs) shall be supplied for field installation on the MCC incoming power cabling
 6. Operator interface shall be via LCD touchscreen for ON, OFF, parameter configuration and display of power quality, operational status and parameter settings
 7. Relay contacts shall be provided for ON, Fault and Load Status
 8. Communication capabilities shall include RS232 and Ethernet/IP

- J. For all systems requiring Active Front End (AFE) drive technology [**PowerFlex 755TL Active Front End Low Harmonic VFD**] [**PowerFlex 755TR Active Front End Low Harmonic Regenerative VFD**] shall be provided (No substitutions)
 1. Rating shall be [**Heavy duty**] [**Normal duty**]
 2. Hardware. VFD shall:
 - a) Use a transistor-based Active Front End as the input rectifier that uses a Selective Harmonic Elimination algorithm, mitigating the harmonics enough to meet IEEE-519-2014 without the need for phase shifting transformers and multi-pulse diode rectifiers. Total current harmonic distortion shall not exceed 5% at the VFD input terminals at full load conditions. AFE rectifier shall be phase rotation insensitive, tolerant of line voltage imbalance up to 10% without affecting the harmonic mitigation or VFD output, and capable of operating the motor at full output with a 10% drop on input voltage.
 - b) Use an LCL filter assembly to filter up to and including the 50th harmonic to reduce EMI/RFI emissions.
 - c) The VFD shall meet the voltage sag ride-through requirements of SEMI-F47.
 - d) Incorporate phase-to-phase and phase-to-ground MOV protection on the AC input line.
 - e) Built-in managed dual EtherNet/IP ports for direct network connections, allowing linear or Device Level Ring topologies. The same network for control must support safety, I/O, and motion control, as well as be able to switch using standard unmodified Ethernet networking equipment.
 - f) Conformal coated printed circuit boards. (all drives)
 3. Input Resonance and Line Side Utility Harmonics Monitoring
 - a) Active front end drives shall be capable of actively monitoring line side (utility) harmonics levels and present a configurable fault or alarm in the event the line side harmonics present a significant impact to the drive reliability. This capability shall be functional at commissioning and actively monitor the utility during operation.

4. Line Side (Utility) Power Factor Correction
 - a) Drive shall be capable of providing line side (utility) power factor correction by utilizing excess drive capacity. Power factor correction shall be configurable via the drives digital interface
5. Refer to section [26 29 23] for specifications:
https://ra.seismic.com/Link/Content/DCrb_C6toVYEaaKXDQE1imrg
- K. For PowerFlex 755 VFDs, the VFD shall accept Rockwell Automation option cards, 20-750S, 20-750-S1, 20-750-S3 and 20-750-S4 that when installed and configured in accordance with the manufacturer's instructions shall meet the certification requirements of TÜV and Rheinland [delete if not needed]

2.16 CONTROL AND LIGHTING TRANSFORMER

- A. Refer to section [26 22 00] for transformer specifications.
 1. Specifications in the MCC section override corresponding specifications in the transformer section
- B. Provide control and lighting transformers as shown on drawings. The rating shown on the drawings shall be the minimum acceptable rating.
- C. The insulation shall be 180 °C insulation with 80 °C rise.
- D. Provide a circuit breaker with thermal magnetic trip for primary protection.
- E. Provide a secondary fuse protection for the transformer.
The primary circuit breaker compartment and transformer compartment shall be interlocked together and factory wired together.
- F. Unit construction is dependent on the MCC NEMA enclosure type.
 1. Units in a NEMA Type 1 enclosure shall be provided with vented doors
 2. Units in a NEMA Type 1 enclosure with gasketed doors shall be provided with filters over the vent openings
 3. Units in a NEMA Type 12 enclosure shall be provided with a non-vented door. If transformer derating is required, then the transformer shall be upsized to provide equivalent rating as shown on the contract drawings
- G. Control and power transformers that are specifically designed for use in motor control centers and for use with motor control circuits are exempt from NEMA TP-1 energy efficient requirements.
- H. Disconnecting means for transformers shall be circuit breakers with thermal-magnetic trip units for 250 A and smaller frames; provide an electronic trip unit for 400 A and larger frames

2.17 LIGHTING and POWER PANELBOARD

- A. Provide lighting panel as shown on the drawings.
- B. Lighting panel shall be rated for 10 kA interrupting capacity.
- C. Provide bolt-on branch breakers as shown on the drawings.

2.18 SOFTWARE

A. Preconfigured Software.

1. Software shall be capable of viewing multiple MCC lineups
2. Software communication driver shall allow the software to be installed and operated on the EtherNet/IP or DeviceNet network
3. Software shall be capable of functioning as a standalone software package or as an ActiveX control in a Human Machine Interface (HMI)
4. Software shall be capable of displaying the following
 - a) Elevation View
 - i. Dynamically displays status information based on reading data from devices in the MCC lineup
 - ii. Sizeable graphical/virtual representation to allow ease of viewing multiple MCC lineups
 - iii. Unit nameplate information
 - iv. Unit status indicators (ready, running, warning, fault, no communication)
 - v. Should be able to add devices, move devices, add sections and move sections
 - b) Unit Monitor View
 - i. Preconfigured for a specific unit
 - ii. Real-time monitoring via real-time analog dials, parameter value display, and data trending
 - iii. Data configurable for customized viewing
 - iv. Modifying device parameters
 - v. Data trend export functionality to .csv file
 - c) Spreadsheet View
 - i. User configurable for customized monitoring displaying maximum information about the lineup
 - ii. Sorting and cascading functions
 - iii. Custom user fields
 - d) Event Log
 - i. Track history of MCC unit
 - ii. Automatic logging of trips, warnings, and changes
 - iii. Manual entry of events
 - e) Documentation
 - i. Front elevation drawings
 - ii. Unit wiring diagrams
 - iii. User manuals
 - iv. Spare parts lists
 - v. Ability to add and/or update documentation

- f) Integration Assistant
 - i. Integrate the MCCs into the PLC software and generate required tags and IP address configurations for devices:
 - a. Choose from device_IP address or Nameplate_IP address for tag naming convention
 - b. Ability to map devices to any EtherNet/IP communication cards in the PLC I/O chassis
 - ii. Integrate the MCCs with energy monitoring software and display real-time device energy consumption data directly in preconfigured software

PART 3 Execution

3.01 INSTALLATION

- A. Contractor shall install MCC in accordance with manufacturer's instructions.
- B. Contractor shall tighten accessible bus connections and mechanical fasteners to the manufacturer's torque requirements.
- C. Contractor shall select and install fuses in fusible switches based upon field requirements.
- D. Contractor shall adjust circuit breaker settings based upon field requirements and/or Arc Flash Study results.
- E. Contractor shall adjust solid state overloads to match the installed motor characteristics.

3.02 MANUFACTURER'S SERVICES

- A. Manufacturer of the MCC shall be capable of providing the programming for the programmable logic controller and the operator interface if provided within the MCC.
- B. Manufacturer of the MCC shall be capable of providing start-up services as part of the supply of the MCC.

3.03 TRAINING

- A. A course outline shall be submitted as part of the MCC submittals.
- B. The manufacturer shall offer off-site training on the concepts, knowledge and tools necessary to design, specify, install, troubleshoot, and use a networked MCC.

PART 4 Safety Technology

4.01 SUPPLEMENTAL INFORMATION REGARDING ARC RESISTANT LOW VOLTAGE MCCs

CENTERLINE 2100 Low Voltage MCCs from Allen-Bradley are available in an arc resistant design that meets the performance criteria described in IEEE C37.20.7 'IEEE Guide for Testing Metal-enclosed Switchgear Rated up to 38 kV for Internal Arcing Faults'.

It should be noted that the safety standard for MCCs (UL 845) has specific equipment performance criteria for LV MCCs during 'bolted fault' short circuits, however, UL845 does not address equipment performance during arc fault/arc flash conditions.

There currently is no recognized standard in North America for arc resistant Low Voltage MCCs that also meet UL 845 requirements. Therefore, the CENTERLINE 2100 MCC with ArcShield™ was designed and tested in accordance with the IEEE C37.20.7 switchgear standard.

When provided within specific criteria requirements, the CENTERLINE 2100 MCC with ArcShield provides Type 2 accessibility as defined by IEEE C37.20.7. Type 2 accessibility provides improved protection to personnel located at the front, sides, and rear of the MCC from the effects of an internal arcing fault.

NOTE: IEEE C37.20.7 also defines a Type 1 accessibility level that provides improved protection to personnel located only at the front of the equipment from the effects of an internal arcing fault.

Rockwell Automation offers two solutions for arc resistant low voltage motor control centers with Type 2 accessibility: Device Limited ArcShield uses specific devices that help limit the amount of available arc fault current distributed through the MCC. Duration Rated ArcShield uses structures and features of the MCC to contain and withstand an arc fault in a specified time duration (100 ms). This is the maximum allotted time for an overcurrent and/or short-circuit protective device to clear a fault.

Required criteria for being able to specify Arc Resistant LV MCCs with Type 2 accessibility:

- A. Main overcurrent and short circuit protective device must be one of the following:
 1. Device Limited
 - a) UL Listed Fuses
 - i. Class L - Any Fuse ≤ 1200 A
 - ii. Class J - Any Fuse ≤ 600 A
 - iii. Class R - Any Fuse ≤ 600 A
 - b) UL Listed Molded Case Circuit Breaker
 - i. Allen-Bradley-Bulletin 140G, Frame G, H, J, K, M, N, or R
 - c) The main protection is allowed to be located remotely from the MCC.

2. 100 ms Duration Rated ArcShield

- a) No limits on the overcurrent and short circuit protective device
- b) No vented units are allowed

- B. Available bolted fault, short circuit current must be 65,000 A or less.
- C. MCC voltage must be 600V or less for Device Limited and 480V or less for Duration Limited
- D. Horizontal power bus must be 1200 A or less for Device Limited or 3000 A or less for 100 ms Duration Rated
- E. The NEMA Type 1 (or 1 with gasket) enclosure available for all unit types.

- 1. Vented units will be provided with arc resistant baffles and cannot use filters over vent openings.

Arc resistant baffles available on Device Limited design only. Arc resistant baffles maintain the Type 2 accessibility level while providing unimpeded airflow during normal operating conditions.

- F. NEMA Type 12 enclosures shall have non-vented designs for all units.
- G. NEMA Type 3R enclosures shall only be used with device limited designs
- H. All equipment listed in arc resistant MCC specification points must be provided.

NOTE: If your application does not meet the preceding criteria, please contact your local Rockwell Automation® distributor or sales office to develop a custom arc-resistant MCC solution that will work for you.

If all of the criteria listed above can be met, include the arc-resistant MCC specification points in your MCC specification.

4.02 OTHER SAFETY OPTIONS

There are many other options that are available to help increase the level of electrical safety in a low-voltage motor control center, such as, the ability to disconnect a plug-in unit from the power bus without opening the door (SecureConnect), finger safe terminal blocks, barriers and guards over fusing and contactors, viewing windows in the doors of units with fusible disconnect switches to verify blade position, and insulated horizontal power bus. If you need these types of options, please include specification language concerning those options in the appropriate sections of the MCC specification.

End of section.

[PROJECT NUMBER]
[DATE]

[PROJECT NAME]
[PROJECT LOCATION]

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