SECTION 26 24 19
MOTOR CONTROL CENTERS
Design Standard

PART 1 GENERAL

1.1 PURPOSE

This design standard has the purpose of creating a consistent application of motor control centers throughout the San Mateo County Community College District therefore achieving a standard of maintenance, reliability and quality throughout all renovation and new building projects.

PART 2 PRODUCTS

2.1 All motor control centers to meet the following requirements based on Code requirements and industry standard of care:

A. Regulatory Requirements:
The MCC must conform to Underwriters Laboratory (UL) 845, current revision, CSA, EEMAC, NEMA ICS-2, the latest version of the National Electrical Code. The MCC must be manufactured in an ISO 9001 certified facility.

B. Do not place motor control centers in hazardous locations. The area chosen shall be well ventilated and totally free from humidity, dust and dirt. The temperature of the area shall be no less than 32F and no greater than 104F. For indoor locations, protection must be provided to prevent moisture entering the enclosure.

C. Locate motor control centers in an area which allow a minimum of 3 feet of free space in front of front-of-board construction. An additional 3 feet should be allowed in the rear of back-to-back construction. This free space will give adequate room to remove and install units. Provide a minimum of 0.5-inch space between the back of front-of-board MCCs and a wall (6 inches required for damp locations).

D. Assemble the MCCs in the factory on a smooth level surface so that sections are properly aligned. Provide a similar smooth and level surface for installation. The surface under a MCC shall be of a noncombustible material unless bottom plates are installed in each vertical section.

2.2 Motor control centers shall include and have the following characteristics but not limited to:

A. Materials:
1. Each MCC shall consist of one or more vertical sections of heavy gauge steel bolted together to form a rigid, free-standing assembly. Mount a removable 7 gauge structural steel lifting angle full width of the MCC lineup at the top. Mount removable 7 gauge bottom channel sills underneath front and rear of the vertical sections extending the full width of the lineup. Vertical sections made of welded side-frame assembly formed from a minimum of 12 gauge steel. Internal reinforcement structural parts shall be of 11 gauge steel to provide a strong, rigid assembly. Construct and package the entire assembly to withstand stresses included in transit and during installation.

B. MCC Finish:
1. Provide steel parts with UL and CSA listed acrylic/alkyd baked enamel paint finish, except plated parts used for ground connections. Painted parts shall undergo a multi-stage treatment process, followed by the finishing paint coat.
2. Pretreatment shall include:
   a. Hot alkaline cleaner to remove grease and oil.
   b. Iron phosphate treatment to improve adhesion and corrosion resistance.

c. Apply paint using an electrodeposition process to ensure a uniform paint coat with high adhesion.
d. Test the standard paint finish to UL 50 per ASTM B117 with no greater than 0.125 in loss of paint from a scribed line.
e. Paint Color: No. 49 medium light gray per ANSI standard Z55.1-967 on surfaces unless specified otherwise.

C. Structures:
1. Totally enclose structures, dead-front, free-standing assemblies. Structures capable of being bolted together to form a single assembly.
2. The overall height of the MCC shall not exceed 90 inches (not including base channel). Base channels, of 1.5 inches in height, shall be removable. The total width of one section shall be 20 inches.
3. Structures: NEMA/EEMAC 1 general purpose, 12 (industrial duty), or 3R non-walk-in (rainproof) depending on installation.
4. Each 20-inch wide standard section shall have the necessary hardware and bussing for modular plug-in units to be added and moved around. Cover unused space with hinged blank doors and equipped to accept future units. Cover vertical bus openings with manual bus shutters.
5. Each section shall include a top plate. NEMA/EEMAC 12 shall also include a bottom plate. Top and bottom plates removable for ease in cutting conduit entry openings.

D. Wireways:
1. Structures shall contain a minimum 12-inch high horizontal wireway at the top of each section and a minimum 6-inch high horizontal wireway at the bottom of each section. These wireways shall run the full length of MCC to allow room for power and control cable to connect between units in different sections.
2. Provide a full-depth vertical wireway in each MCC section that accepts modular plug-in units. The vertical wireway shall connect with both the top and bottom horizontal wireway and isolated from unit interiors by a full height barrier. The vertical wireway 4 inches wide minimum with a separate hinged door. There should be a minimum of 4,000 in^3 of cabling space available. Access to the wireways shall not require opening control unit doors. Structures that house a single, full section control unit are not required to have vertical wireways. Those control units must open directly into the MCC horizontal wireways.

E. Barriers:
1. Isolate power bussing and splice connections from the unit compartments and the wireways. Mount the horizontal bus onto a glass filled polyester support assembly that braces the bus against the forces generated during a short circuit. Isolate the horizontal bus from the top horizontal wireway by a two-piece grounded steel barrier. Provide removable barrier to allow access to the bus and connections for maintenance.
2. House the vertical bus in a molded glass-filled polyester support that provides bus insulation and braces the bus against the forces generated during a short circuit. These supports shall have openings every 3 inches for unit stab-on connections. Provide each opening with a manual shutter to close off the stab opening. Attach these shutters to the structure so that when they are removed they are retained in the structure and are readily accessible for use should a plug-in unit be removed from the MCC.
3. Provide barriers in the vertical structure and unit designs to prevent the contact of any energized bus or terminal by a fishtape inserted through the conduit or wireway areas.

F. Bussing:
1. Bussing and Connectors: Tin-plated or silver-plated copper.
2. Main Horizontal Bus: Rated at 600A, 800A, 1200A, 1600A, or 2000A continuous and shall extend the full length of the MCC. Base bus ratings on 65C maximum

temperature rise in a 40C ambient. Provide provisions for splicing additional sections onto either end of the MCC.

3. Horizontal Bus Splice Bars: Preassembled into a captive bus stack. This bus stack is installed into the end of the MCC power bus to allow the installation of additional sections. The main bus splice shall utilize four bolts, two on each side of the bus split, for each phase. Additional bolts must not be required when splicing higher amperage bus. The splice bolts shall secure to self clenching nuts installed in the bus assembly. It shall be possible to maintain any bus connection with a single tool. "Nut and bolt" bus connections to the power bus shall not be permitted.
4. Provide each section that accepts plug-in units with a vertical bus for distributing power from the main bus to the individual plug-in starter units. This bus shall be of the same material and plating as the main bus, and rated at 300A or 600A continuous. Connect the vertical bus directly to the horizontal bus stack without the use of risers or other intervening connectors. It shall be possible to maintain the vertical to horizontal bus connection with a single tool. "Nut and bolt" bus connections to the power bus are not permitted. When a back-to-back unit arrangement is utilized, provide separate vertical bus for both the front and rear units.
5. Provide a tin-plated copper ground bus that runs the entire length of the MCC. Ground bus: 0.25 by 1 inch and rated for 300 amps. Provide a compression lug in the MCC for a 4/0-250 kcmil ground cable. Provide the ground bus with six 0.38-inch holes for each vertical section to accept customer-supplied ground lugs for any loads requiring a ground conductor.
6. Each vertical section shall have a copper vertical ground bus that is connected to the horizontal ground bus. Install this vertical ground bus so that the plug-in units engage the ground bus prior to engagement of the power stabs and shall disengage only after the power stabs are disconnected upon removal of the plug-in unit.
7. Brace the power bus system for a short circuit capacity as determined by information from the utility and a short circuit study.

G. Unit Construction:

1. Units with circuit breaker disconnects through 250A frame, and fusible switch disconnects through 200A, shall connect to the vertical bus through a spring reinforced stab-on connector. Connect units with larger disconnects directly to the main horizontal bus with appropriately sized cable or riser bus. Stabs on plug-in units shall be solidly bussed to the unit disconnect. Cabled stab assemblies are not permitted.
2. Conducting parts on the line side of the unit disconnect shrouded by a suitable insulating material to prevent accidental contact with those parts.
3. Unit mounting shelves shall include hanger brackets to support the unit weight during installation and removal. Plug-on units shall use a twin-handle camming lever located at the top of the bucket to rack in and out the plug-on unit. The cam lever shall work in conjunction with the hanger brackets to ensure positive stab alignment.
4. A cast metal handle operator must be provided on each disconnect. With the unit stabs engaged into the vertical phase bus and the unit door closed, the handle mechanism shall allow complete ON/OFF control of the unit disconnect with clear indication of the disconnects status. Circuit breaker operators shall include a separate TRIPPED position to clearly indicate a circuit breaker trip condition. It shall be possible to reset a tripped circuit breaker without opening the control unit door.
5. A mechanical interlock shall prevent the operator from opening the unit door when the disconnect is in the ON position. Another mechanical interlock shall prevent the operator from placing the disconnect in the ON position while the unit door is open. It shall be possible for authorized personnel to defeat these interlocks.

6. Provide a nondefeatable interlock between the handle operator and the cam lever to prevent installing or removing a plug-on unit unless the disconnect is in the OFF position.
7. The plug-in unit shall have a grounded stab-on connector which engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors.
8. Provide provisions for locking disconnects in the OFF position with up to three padlocks.
9. Locate handle mechanisms on the left side to encourage operators to stand to the left of the unit being switched.
10. Unit construction shall combine with the vertical wireway isolation barrier to provide a fully compartmentalized design.

H. High Density Unit Construction:
1. Units with circuit breaker disconnects through 100 A frame, and fusible switch disconnects through 100 A, shall connect to the vertical through a spring-reinforced stab-on connector. Cable connect stabs on plug-on units to the unit disconnect. High density units shall accept Class J fuses only and to be rated for 100,000 AIR (amperes interrupting rating) at 600 volts. Rate high density units with breakers for 65,000 AIR at 480 volts.
2. Conducting parts on the line side of the unit disconnect be shrouded by a suitable insulating material.
3. Unit mounting shelves shall include hanger brackets to support the unit weight during installation and removal. High density units installable without the assistance of a camming device so as to allow maximum accessibility with the unit installed.
4. Provide a cast metal handle operator on each disconnect. With the unit stabs engaged into the vertical phase bus and the unit door closed, the handle mechanism shall allow complete ON/OFF control of the unit disconnect with clear indication of the disconnects status. Circuit breaker operators shall include a separate TRIPPED position to clearly indicate a circuit breaker trip condition. It shall be possible to reset a tripped circuit breaker without opening the control unit door.
    a. A mechanical interlock shall prevent an operator from opening the unit door when the disconnect is in the ON position. Another mechanical interlock shall prevent an operator from placing the disconnect in the ON position while the door is open. It shall be possible for authorized personnel to defeat these interlocks.
    b. Provide a nondefeatable interlock between the handle operator and the structure to prevent installing or removing a plug-on unit unless the disconnect is in the OFF position. The plug-on unit shall have a grounded stab-on connector which engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors.
5. Provide provisions for locking disconnects in the OFF position with up to three padlocks.
6. Locate handle mechanisms on the bottom left side of the unit and operate horizontally to encourage operators to stand to the left of the unit being switched.
7. Unit construction shall combine with the vertical wireway isolation barrier to provide a fully-compartmentalized design.
8. Up to a maximum of 12 high-density units can be installed per vertical section without placement restrictions in new or existing applications.

I. Components:
1. Combination Starters:
    a. Combination starters shall utilize a unit disconnect as specified in the previous article. Furnish magnetic starters in combination starter units. Starters shall utilize NEMA/EEMAC rated contactors. Provide starters with a 3 pole, external manual reset, overload relay for thermal overload units.

b. When provided, control circuit transformers shall include internal primary protection 208V to 480V (separate primary fuse on 600V) and one secondary fuse (in the nonground secondary conductor). Size the transformer to accommodate the contactor(s) and connected control circuit loads. The transformer rating fully visible from the front when the unit door is opened.
c. When a unit control circuit transformer is not provided, the disconnect shall include an electrical interlock for disconnection of externally powered control circuits.
d. Provide auxiliary control circuit interlocks where indicated. Auxiliary interlocks field convertible to normally open or normally closed operation.
e. Mount NEMA/EEMAC Size 1-4 starters directly adjacent to the wireway so that power wiring (motor leads) shall connect directly to the starter terminals without the use of interposing terminals. Arrange larger starters so that power wiring may exit through the bottom of the starter cubical without entering the vertical wireway.

2. Terminal Blocks:
a. Provide Type B wiring. Provide starter units with unit control terminal blocks.
b. Terminal Blocks: Pull-apart type 600 volt and rated at 25 amps. Tin plate current carrying parts. Terminals accessible from inside the unit when the unit door is opened. Terminal blocks shall be DIN rail mounted with the stationary portion of the block secured to the unit bottom plate. Use the stationary portion for factory connections, and shall remain attached to the unit when removed. The terminals used for field connections shall face forward so they can be wired without removing the unit or any of its components.
c. When Type C wiring is specified, provide starter units with unit control terminal blocks as described for Type B wiring. Provide an additional set of identical terminal blocks in a terminal compartment located in each section. Prewire these terminal blocks to the unit terminals so that field control connections can be made at the terminal compartments.

J. Components For High Density Units:
1. High Density Combination Starters:
a. High density combination starters shall use a unit disconnect as specified in the previous article. NEMA rated units shall use magnetic starters and furnished in high density combination starter units. Starters shall use NEMA/EEMAC-rated contactors. Provide starter units with a 3 pole, external manual reset, overload relay for motor overload protection.
b. When provided, control circuit transformers shall include internal primary protection 280V to 480V, and one secondary fuse (in the nonground secondary conductor.) Size the transformer to accommodate the contactor(s) and connected control circuit loads.
c. When a unit control circuit transformer is not provided, the disconnect shall include an electrical interlock for disconnection of externally powered control circuits.
d. Provide auxiliary control circuit interlocks. For NEMA rated starters, auxiliary interlocks field convertible to normally open or normally closed operation.
e. Mount NEMA/EEMAC size 1 starters directly adjacent to the wireway so that power wiring (motor leads) will connect directly to the starter terminals.

2. Terminal Blocks for High Density Units
a. Provide starter units with unit control terminal blocks.
b. Terminal Blocks: Pull-apart type, 250V, and rated for 10 amperes. Tin plate current-carrying parts. Terminals accessible from inside the unit when the unit door is opened. Use the stationary portion of the terminal block for factory connections and will remain attached to the unit when the portion used for field connections is removed. The terminals used for field connections accessible so they can be wired without removing the unit or any of its components.

3. Pilot Device Control Panel: Provide each unit with a control panel for up to a maximum of four pilot devices. Control panel to be removable by loosening two semi-captive fasteners for customer access.

2.3 APPROVED MANUFACTURERS

A. Square D
B. Siemens
C. Eaton Electrical
D. General Electric

PART 3 EXECUTION

3.1 SUBSTITUTES ALLOWED?

Yes, if performance and quality equivalency can be evidenced.

3.2 ASSOCIATED DESIGN STANDARDS AND CONSTRUCTION SPECIFICATIONS

A. Division 26 Electrical Design Standards and Construction Specifications

END OF SECTION