MOTOR CONTROL CENTERS

Part 1 GENERAL

1.1 SUMMARY

A. Section Includes
    1. Low Voltage Motor Control Centers (MCCs)

1.2 REFERENCES

A. The MCCs shall meet or exceed the requirements within the following standards for MCCs.
    1. NEMA ICS-18
    2. UL845
    3. NEC (NFPA 70)
    4. CSA (cUL)
    5. EN 60439

B. The MCCs shall be designed, manufactured, and tested in facilities registered to the following quality standards.
    1. ISO 9001

1.3 DESIGN REQUIREMENTS

A. Provide MCCs based on NEMA standards and in accordance with the detailed specifications and Plans.
B. The manufacturer of the MCCs shall also be the manufacturer of the SSRVs and/or PowerMonitor. The use of third-party supply and assembly of these components in not acceptable and will be rejected.

1.4 SUBMITTALS

A. A submittal shall be supplied within 6-8 weeks following an acceptable order.
B. Shop Drawings are required, with the following:
    1. MCC elevation drawings showing dimensional information.
    2. Structural descriptions shown:
        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 starter sizes, circuit breaker frame sizes, circuit breaker continuous amp ratings, pilot devices, etc.

6. Nameplate information
7. Schematic wiring diagrams

C. Product Data
   1. Motor Control Center Publications
   2. Data sheets and publications on all major components including but not limited to the following
      a. Motor starters
      b. Circuit breaker and fuse information including time current characteristics
      c. Control power transformers
      d. Pilot devices
      e. Relays

D. Specification Response
   1. MCC manufacturer to include as part of the Submittals a "letter of compliance" to the specification. This should identify all clarifications and/or exceptions to the specification.
   2. All clarifications and exceptions must be clearly identified.

E. Testing and Test Reports
   1. Testing shall be per manufacturer's standard.
   2. A copy of the test reports shall be provided of the final documentation.

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

1.5 OPERATION & MAINTENANCE MANUALS

A. O&M Manuals (Qty 2 hardcopy and Qty 1 electronic copy) shall be supplied at the conclusion of the project, specifically within 2-3 weeks after the final commissioning.

B. The Installer shall provide certification that the MCC has been installed in accordance with the manufacturer's instructions.

C. The Installer shall provide certification that all circuit breaker settings (if applicable) have been adjusted per field requirements.

D. The Installer shall provide certification that all power fuses (if applicable) have been selected and installed per field requirements.

E. The Installer shall provide certification that all non-networked thermal overload elements (if applicable) have been supplied and installed per installed motor characteristics.
F. The Integrator shall provide certification that any networked solid-state motor overload settings (if applicable) have been adjusted per installed motor characteristics.
G. The Integrator shall provide certification that any timing devices required in the starting circuitry have been properly adjusted.
H. Final Drawings. The MCC Manufacturer shall provide final drawings reflecting the "As Commissioned" status of the MCC.
I. Maintenance Data
    1. MCC installation instructions
    2. Installation / Operation instructions for major components such as automatic transfer switch, circuit breakers, etc.
    3. MCC spare parts listing and pricing
    4. Name and phone number for a local distributor for the spare parts.

1.6 QUALITY ASSURANCE

A. The manufacturer of the MCCs shall be the manufacturer of the SSRVs and PowerMonitor as required on this project.

1.7 REGULATORY REQUIREMENTS

A. Installation shall conform to the requirements of the latest edition of the National Electric Code.
B. MCCs shall be constructed to meet or exceed the latest UL requirements.

1.8 QUALIFICATIONS

A. The manufacturer shall have ISO 9001 registered facilities for the design, manufacture and testing of MCCs.

1.9 DELIVERY, STORAGE AND HANDLING

A. The Installer shall coordinate the shipping splits with the MCC manufacturer for entry into the building. The MCC Manufacturer shall provide shipping split information to the Installer within 2 weeks after a "Notice to Proceed" to manufacturing.
B. The Installer shall store the MCCs in a clean, dry and heated space.
C. The Installer shall protect the units from dirt, water, condensation, construction debris and traffic.
D. During storage, the Installer shall connect internal space heaters (if specified) with temporary power.
E. 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 rated for the environment appropriate for its location.

1.11 FIELD MEASUREMENTS

A. The Installer shall verify all field measurements (such as dimensions, "stub-up" locations, entry/exit locations, motor/load data, etc.) prior to the fabrication of the MCC.

B. The Integrator shall coordinate through the Installer to verify all load requirements prior to the fabrication of the MCC to see that each motor starter, SSRV and/or VFD is properly sized for the driven load. The MCC Manufacturer shall include in his Submittal a letter from the Integrator verifying the loads of the MCC.

1.12 WARRANTY

A. The manufacturer shall provide a parts warranty for twelve months from the date of "Project Acceptance".
B. The manufacturer shall confirm this warranty as part of the submittal.

1.13 SPARE MATERIALS

A. Provide three of each size power fuse utilized.
B. Provide spare fuses equal to 10% of the installed quantity for primary and secondary control power transformer protection.
C. Provide one spare stand-alone SSRV for each unique current rating utilized in the MCCs.
D. Provide one can of spray touchup paint, ANSI 49.

PART 2 MOTOR CONTROL CENTER SPECIFICATIONS

2.1 MANUFACTURERS

A. Centerline by Rockwell Automation® Allen-Bradley
B. No substitutions allowed.

2.2 RATINGS

A. Voltage: Unless shown differently on the Plans, the MCCs shall be rated for 600V system.
B. Short Circuit Withstand Rating: The MCCs shall be rated for a minimum fault current of 35,000A.

2.3 ENCLOSURE

A. The MCC shall be NEMA Type 1 with gasketing.
B. Removable end plates on each end of the MCC shall cover all horizontal bus and horizontal wireway openings.
C. Each section shall be equipped with two full metal side sheets to isolate each vertical section.
D. 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.
E. All unpainted parts shall be plated for corrosion resistance.

2.4 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. Vertical sections shall be 90 inches high, 20-inches deep and 20-inches wide, except where indicated on the Plans as different.
    3. 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.
C. Provide full depth horizontal wireways at the top and bottom of the MCC.
    1. The horizontal wireways shall be isolated from the bus.
    2. 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.

2.5 UNIT INFORMATION

A. The minimum compartment height shall be 13 inches and this shall be considered one space factor. One-half space factor compartment shall only be supplied when specified in the Plans.

B. Plug-In units
   1. Plug-in units shall consist of 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.
   4. 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.

C. Power Stabs
   1. Unit stabs for engaging the power bus shall be tin-plated copper and provided with stainless backup 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 to 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. The power cable termination at the plug-in stab shall be a maintenance free crimp type.

D. Handle
   1. Units shall be provided with a heavy-duty, non-conductive industrial, flange mounted handle mechanism for control of each disconnect switch or circuit breaker.
   2. The operator units may pivot in the vertical plane. Horizontal operator units shall not be allowed.
   3. The 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 I and O along with a pictorial indication of the handle position.
   4. Handles shall be capable of being locked in the OFF position with up to three padlocks.
   5. The operator handle shall be interlocked with the unit door so the disconnect cannot be switched to the ON position unless the unit door is closed. A means shall be provided for purposely defeating the interlock during maintenance or testing.

6. The operator handle shall be interlocked with the unit so that the unit cannot be inserted or withdrawn with the operator handle in the ON position.

E. Pilot Devices
   1. Unless otherwise specified, units shall be furnished with NEMA Type 4/13 water-tight / oil-tight pushbuttons, selector switches or pilot lights.
   2. When three or less pilot devices are utilized, the devices shall be 30.5mm devices. When more than three devices are required, the use of 22.5mm devices is permitted.

F. Terminal Blocks
   1. Control terminal blocks shall be pull-apart on all plug-in units for easy removal of the unit from the structure.
   2. Control terminal blocks on factory mounted units shall be fixed type.
   3. Provide power terminal blocks on starters, rated NEMA size 3 and below. Power terminal blocks shall be pull-apart for NEMA size 1 and 2. Power terminal blocks for NEMA size 3 starters shall be non-pull-apart. Power terminal blocks are not required on NEMA size 4 and above.
   4. Terminal blocks shall not be located adjacent to or inside the vertical wireway.

2.6 BUS BARS

A. Horizontal Power Bus
   1. The horizontal bus shall be rated as shown on the Plans.
   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-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.

B. Vertical Bus
   1. The vertical power bus shall have an effective rating of 600A. If a center horizontal bus construction is utilized, then the rating shall be 300A above and below the horizontal bus for an effective rating of 600A. If a top or bottom mounted horizontal bus is utilized, then the full bus must be rated for 600A.
   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 tracking glass-filled polyester material and sandwiched by a poly-carbonate molded cover.

5. 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 copper (0.25 inch by 1 inch) horizontal ground bus mounted in the top or bottom of the MCC.
   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 plugin power stabs are disengaged.

D. Neutral Bus
   1. Not applicable.

2.7 METERING COMPARTMENT

A. The MCC shall include a plug-in metering unit

B. The unit shall include the following
   1. Fusible disconnect with fuses
   2. Fused control circuit transformer
   3. Current transformers shipped loose to be installed in the field
   4. Powermonitor with door mounted display

C. Powermonitor
   1. The powermonitor shall be Powermonitor 5000 M5 Series by Allen-Bradley.
   2. The powermonitor 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 fullscale 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 45^{th} harmonic
      h. Frequency at plus or minus 0.5 percent
      i. Power factor at plus or minus 0.4 percent
   3. The powermonitor shall include min / max logs and trend logs with up to 45,867 data points.
   4. The powermonitor shall be capable of performing distortion analysis with THD, Crest Factor (I, V) and Distortion power factor.
   5. The powermonitor shall include Ethernet/IP communications.

6. The powermonitor shall include two form C relays.

2.8 DISCONNECTS

A. Main Circuit Breaker Disconnect
   1. The withstand rating of the Main shall be greater than or equal to the bus bracing for the MCC.
   2. Provide lugs to accommodate the conductors as indicated on the Plans.
   3. Size the circuit breaker as shown on the Plans.
   4. Provide a circuit breaker of either the thermal magnetic or solid-state type.
   5. Provide a removable protective barrier to reduce the possibility of contact with the line terminals.
   6. Provide one normally open and one normally closed internal auxiliary contact.
   7. MCC-1 shall be rated for 800AF/600AT. MCC-2 shall be rated for 800AF/800AT.

B. Feeder Disconnects and Transformer Disconnects
   1. The disconnecting means for feeders and transformers shall be thermal magnetic circuit breakers.
   2. The interrupting capacity rating shall be greater than or equal to the bus bracing requirement.
   3. The minimum frame size shall be 150 amps
   4. Provide one (1) N.O. internally mounted auxiliary contact for indication of "On" or "Off/Tripped."

C. Motor Starter Disconnect
   1. Solid-State Controllers (SSRVs)
      a. The disconnecting means for solid-state controllers shall be circuit breakers.

2.9 SOLID-STATE REDUCE VOLTAGE (SSRV) CONTROLLERS

Note: In this section, the term "SSRV Controller" refers to the base SSRV component that will be mounted within the MCC enclosure bucket/section. The term "SSRV System" refers to the SSRV Controller plus all other peripheral items mounted within the MCC enclosure bucket/section containing the SSRV Controller.

A. With no exceptions, the SSRV Controller unit shall be:
   1. SMC-Flex by Allen-Bradley

B. The SSRV Controller shall be provided with an integral SCR bypass (at-speed) contactor. The integral SCR bypass contactor shall be energized once the motor is up to full speed. The SSRV Controller should also include electronic overload protection with adjustable trip class and configurable auxiliary contacts.

C. The SSRV System shall be provided with a 120V control power transformer. The control power transformer shall be provided with primary and secondary fusing.
D. The SSRV Controller shall contain metal oxide varistors (MOVs) that protect the internal power circuitry from severe electrical transients.
E. The SSRV Controller shall contain an RC Snubber Network for dv/dt protection.
F. The SSRV System shall be provided with a door-mounted Hand-Off-Auto Selector Switch for start-stop control. Pilot lights for indication of the "Hand" and "Auto" modes will be provided. The devices shall be NEMA Type 4/4X/13 pilot devices mounted on the enclosure door.
G. The SSRV controller system shall be provided with door-mounted pushbuttons for start-stop. Stop pushbuttons shall always be active.
H. The SSRV controller system shall be provided with door-mounted transformer type pilot lights for indication of On (Red) and Off (Green).

PART 3 EXECUTION

3.1 COORDINATION

A. Supply (i.e. procurement) of the MCCs is intended to be the responsibility of the Electrical Contractor or System Integrator. The Supplier shall give procurement preference to the MCC Manufacturer's distributor that is most local to the jobsite (McNaughton-McKay Electric, Charlotte, NC 704-527-6555)
B. Installation of the MCCs shall be the responsibility of the Electrical Contractor. Power wiring and control wiring to/from MCC buckets and field devices shall be the responsibility of the Electrical Contractor.
C. Integration of the networked content within the MCCs is intended to be the responsibility of the System Integrator. _____

3.2 INSTALLATION

A. The Installer shall be responsible for installing the MCC(s) in accordance with manufacturer's instructions.
B. The Installer shall tighten accessible bus connections and mechanical fasteners to the manufacturer's torque requirements.
C. The Installer shall supply and install fuses in fusible switches based upon field requirements.
D. The Installer shall adjust circuit breaker setting based upon field requirements.
E. The Installer shall supply and install any non-networked overload elements to match the installed motor characteristics.

F. The Integrator shall adjust any networked solid-state overloads to match the installed motor characteristics.
G. The Installer shall pull and land all power and control wiring between MCC buckets, field devices and

3.3 CONTROL SYSTEM INTEGRATION

A. The Integrator shall be Fortech, Inc. and is responsible for system integration between the MCC (including SSRVs and PowerMonitor) and the existing plant SCADA. The SCADA system shall include updated graphics, status of the equipment and power monitor trending

3.4 MANUFACTURER'S SERVICES

A. The MCC Manufacturer shall provide SSRV Start-up services. The start-up services shall be performed by a trained Field Service Engineer who is a degreed engineer and employee of the MCC Manufacturer. All costs (travel, expenses, potential stand-by time) shall be included in the start-up services. The MCC/SSRV manufacturer shall be responsible for coordinating with the Integrator to avoid/minimize stand-by time. A minimum of 2 hours per SSRV of on-site service shall apply.
B. At a minimum, the start-up service shall include:
    1. Pre-Power Check
        a. Megger motor resistances: phase-to-phase and phase-to-ground
        b. Verify system grounding per manufacturer's specifications
        c. Verify power and ground signals
        d. Check connections
        e. Check environment
    2. Power-Up and Commissioning
        a. Measure incoming power: phase-to-phase and phase-to-ground
        b. Measure AC current: unloaded and loaded
        c. Measure output voltage: phase-to-phase and phase-to-ground
    3. Record all measurements
    4. Provide final parameter listing
C. Should there be a SSRV or combination of SSRVs having the possibility of being run on Generator power, the SSRV Manufacturer shall provide the services of a Field Service Engineer to supervise/assist in the start-up on Generator power.

3.5 TRAINING

A. The MCC manufacturer shall provide (1) 2-hour on-site training course on the basic operation, maintenance and troubleshooting of any MCC-resident SSRVs utilized on the project. Coordination shall be the responsibility of the MCC Supplier. All costs (travel and expenses) shall be included.

B. At a minimum, the training shall include:

1. Review of the final drawings identifying major components.
2. Review starting/stopping procedures and options for the various controllers/starters.
3. Review operation of the Human Interface Modules (if applicable) for programming and monitoring of the system(s).
4. Review the maintenance requirements of the system(s).
5. Review safety concerns of the system(s).