SECTION 26 24 19 – LOW VOLTAGE MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The Conditions of the Contract and applicable requirements of Divisions 0 and 1 and Section 26 00 01, “Electrical General Provisions”, govern this Section.

1.2 DESCRIPTION OF WORK:

A. Work Included: The extent of motor control center work is as shown and scheduled, as indicated by the requirements of this Section, and as specified elsewhere in these Specifications.

B. Types: The types of motor control centers required for the project include, but are not limited to, 600 volt motor control centers.

1.3 STANDARDS:

A. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:

1. ANSI/NEMA ICS 6 Enclosures for Industrial Controls and Systems.
2. NEMA ICS 2 Industrial Control Devices, Controllers, and Assemblies.
3. NEMA AB 1 Molded Case Circuit Breakers.
4. NEMA PB 1.1 Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

1.4 QUALITY ASSURANCE:

A. Manufacturers: Provide products complying with these specifications and produced by one of the following:

1. Cutler-Hammer, Inc.
2. General Electric Company.
3. Square D Company.
4. Siemens.

B. UL-Labels: Provide motor control centers which have been UL-Labeled.

1.5 SUBMITTALS:

A. Shop Drawing submittals shall include, but not be limited, to the following:

1. Cut sheets of the motor control center with construction, bus ratings, voltage, phase, integrated equipment rating and all associated accessories clearly indicated.
2. Cut sheets of the motor starters with NEMA size, voltage, poles, and all associated accessories clearly indicated.
3. Cut sheets of the circuit breakers with amperage, or frame and trip size, interrupting rating, voltage, and poles clearly indicated.
4. Include dimensioned drawings of motor control centers showing accurately scaled basic units and including, but not necessarily limited to, auxiliary components, unit components, and combination units.
5. Additional information as required in Section 26 00 01, Electrical General Provisions”.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver motor control centers in factory-fabricated water resistant wrapping, and mounted on shipping skids.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle motor control centers carefully to avoid damage to material components, enclosure and finish. Motor control centers shall be provided with adequate lifting means.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS:

A. General: Except as otherwise indicated, provide motor control center manufacturer's standard materials and components as indicated by his published product information, designed and constructed as recommended by the manufacturer, and as required for a complete installation.

2.2 600 VOLT MOTOR CONTROL CENTERS:

A. General: Provide a factory-assembled, dead front, NEMA 1 construction only indoor NEMA 3R for outside as subject to moisture metal-enclosed, self-supporting motor control center of the voltage, phase, ampacity, and short-circuit bracing shown.

1. Motor control centers shall consist of the required number of vertical sections bolted together to form one metal-enclosed rigid structure.
2. Motor control centers shall include all starters, protective devices, and equipment as shown with necessary interconnections, instrumentation, and control wiring. Small wiring, necessary fuse blocks, and terminal blocks within the motor control center shall be furnished. All groups of control wires leaving the motor control center shall be furnished with terminal blocks with suitable numbering strips. Wiring shall be NEMA Class I, Type "B", unless specifically shown otherwise.

B. Enclosure Construction: The motor control center framework shall be fabricated on a die-formed steel base or base assembly consisting of formed steel and commercial channel welded or bolted together to rigidly support the entire shipping unit for moving on rollers and floor mounting. The framework shall be formed code gauge steel, rigidly welded and bolted together to support all coverplates, busing and component devices during shipment and installation.

1. Each motor control center section shall have an open bottom and individually removable top plate for installation and termination of conduit. Top and bottom conduit area shall be clearly shown and dimensioned on the shop drawings. All front plates used for mounting meters, selector switches, or other front-mounted devices shall be hinged, with all wiring installed and laced and with flexibility at the hinged side. All closure plates shall be small enough for easy handling by one man and held in place with slotted quarter turn fasteners. Doors shall be held closed with captive knurled thumb screws.
2. An isolated horizontal wiring trough shall be included at the top of each vertical section. Each section shall be arranged so that when bolted with adjacent vertical sections, the wiring trough will form a convenient pull box arrangement running the entire length of the motor control center. Each section shall also have a full height, isolated, non-obstructed, completely accessible, vertical wiring trough between the side and the starter units. Wire straps shall be furnished in the vertical wireway to group and securely tie wires in place for a neat, orderly installation. End sections shall have end closing plates which can be removed for the addition of future sections. Removable blank doors shall cover all

unused unit spaces. All buckets shall be removable without de-energizing the whole MCC.

3. Unit space of a section shall be allocated into six 12" space modules or other sizes in multiples of 6" for unit arrangements. Size 1 and Size 2, across the line, non-reversing, combination starter units, except those with 100 ampere fuse clips, shall fit into one space to permit simple rearrangement in the field.
4. A main lug compartment shall be included complete with suitable main lugs to accommodate incoming cables. The compartment shall be located in the topmost or bottom-most unit space of the section as indicated.
5. All steel surfaces shall be chemically cleaned and treated to provide a bond between paint and metal surfaces to help prevent the entrance of moisture and formation of rust under the paint film. The paint finish shall be manufacturer's standard gray enamel over a rust inhibiting phosphate primer.

[select conductor type]

C. Busing: The motor control center busing shall be silver-plated copper, and of sufficient cross section area to continuously conduct rated full-load current with a maximum temperature rise of 50³C above an ambient temperature of 40³C.

1. The bus bars shall be rigidly braced to comply with the integrated equipment rating of the motor control center. The main horizontal bus bars between sections shall be located near the top of the motor control center. The horizontal main bus bar supports, connections and joints shall be bolted or welded, as required, so as not to require periodic maintenance. All bolted joints shall be bolted with medium carbon steel, zinc or cadmium-plated hardware equipped with lock washers and torqued to the manufacturer's recommended settings (usually ASTM standards) and witnessed by AHJ. All bolted connections shall have Belleville washers. Furnish a neutral block in the lug compartment where required.
2. Buses shall be arranged A-B-C, left-to-right, top-to-bottom, and front-to-rear throughout. A ground bus shall be secured to each vertical section structure and extend the entire length of the motor control center.
3. Insulated horizontal and vertical bus barriers shall reduce the hazard of accidental contact. Vertical bus barriers shall have closing plates to close off all unused openings. Bottom bus covers shall be included below the vertical bus to protect the ends of this bus from contact with fish tapes or other items entering the bottom of the enclosure. All drawout units shall be retained in the operating position by two conveniently located positive latching mechanisms. Units shall be capable of being withdrawn to a test position (disengaged from bus) and padlocked.
4. Provide fully equipped spaces for future devices with bussing and bus connections, braced for available short circuit currents, as indicated on Drawings. Provide provision for future extension of main horizontal bus.

[SELECT ONE OF THE FOLLOWING]

D. Motor Control Devices: Each motor control device shall be a combination motor control unit consisting of a magnetic starter in combination with a circuit breaker. All started shall have phase loss protection. Each unit shall be rated as shown and required by equipment served. All starters shall contain independent control transformers, connections between others shall be interlocked.

1. Provide full-voltage, non-reversing, single-speed, full-voltage, non-reversing (FVNR), 2-speed, 1-winding (2S-1W), 2-speed, 2-winding (2S-2W) or reduced voltage, non-

reversing auto-transformer type closed transition starters sized as shown. Size and number of poles shall be as shown and required by equipment served. All starters shall be constructed and tested in accordance with the latest NEMA standards and shall be NEMA standard sizes. IEC sizes are not acceptable.

[SELECT ONE OF THE FOLLOWING]

2. Provide circuit breakers [for all starters except autotransformer RVNR starters which shall have circuit breakers,] as specified hereinbelow.
3. Magnetic starter contacts shall be solid silver cadmium oxide alloy and shall not require any filing, dressing, or cleaning throughout the life of the starter.
4. Operating coils shall be 120 volts, pressure molded, and designed so that accidental exposure to excessive voltage up to 480 volts will not damage the coil. The starter design shall also be such that when a coil fails due to an over voltage condition, the starter shall definitely open and shall not freeze in the closed position.
5. All starters shall have manual reset, trip-free overload relays in each phase conductor. Overload relays shall be melting alloy type with visual trip indication. Relays shall provide 3 phase overload protection. All 3 phase and single phase starters shall have one overload relay in each underground conductor. Two speed starters shall have overload relays in all six underground conductors. Relay shall not be field-convertible from manual to automatic reset. **[All starters shall have manual reset, trip-free Selectable Class 10/20/30 solid state overload relays. Overload relays shall have visual trip indication. Relays shall provide protection against phase current loss, and phase current unbalance for all 3 phases. Relay shall not be field-convertible from manual to automatic reset. Relay shall have adjustable full load current dial.]**

E. Provide red (run) and green (not running) pilot lights for all motor starters. Provide FAST and SLOW pilot lights for all 2-speed starters. Furnish additional pilot lights for motor starters as shown. Pilot lights shall be mounted in the starter enclosure cover. Pilot lights shall be operated from an interlock on the motor starter and shall not be wired across the operating coil. Pilot lights shall be LED type.

1. Provide starters with HAND-OFF-AUTOMATIC switches or START/STOP pushbuttons as shown or required. All 2-speed starters shall have deceleration relays between fast and slow speeds. Coordinate motor starter controls with the requirements of Division 15. Motor starter controls shall be mounted in the starter enclosure cover.
2. A single-phase control power transformer shall be included integrally with each motor control unit for 120 volt control power. The primary shall be connected to the line side of the motor starter and shall have both legs fused; the secondary shall have one leg fused and one leg grounded. Arrange transformer terminals so that wiring to terminals will not be located above the transformer.
3. Each motor starter shall have one normally open and one normally closed convertible auxiliary contact in addition to the number of contacts required for the "holding interlock" and control wiring. In addition, it shall be possible to field-install one or more additional auxiliary contacts without removing existing wiring or removing the starter from its enclosure.
4. Unit shall be completely prewired to terminals to eliminate any interior field-wiring except for:
   a. Connection of power supply conductors to switch line side terminals.
   b. Motor leads to the starter load side terminals.
   c. Control conductors to holding coil terminals.

5. The units shall be removable from the vertical bus without disturbing the wiring of the individual motor starter unit and permit starter door to be closed and fastened when removed. Means shall be included to prevent the incorrect operation of the stab-in mechanism. Each individual removable unit shall be held in place with a positive-acting center toggle mechanism. Motor starter units up through NEMA Size 4 shall be provided with the stab-in mechanism.

F. Phase Failure Protection: Provide a Square D Type MPS, Taylor Phase Guard, Diversified Electronics, in the incoming lug section of each motor control center. Relay shall be wired to monitor the incoming line of the motor control center and shall open a multi-pole interface relay on detection of a phase failure or reversal. The multi-pole interface relay shall have one pole for each installed starter or space in the motor control center. The control power circuit of each starter shall be factory-wired through a normally closed contact on the interface relay**.[delete this paragraph if solid state relays used]**

G. Integrated Equipment Rating: Each motor control center, as a complete unit, shall be given a single integrated equipment rating by the manufacturer. The integrated equipment short-circuit rating shall certify that all equipment is capable of withstanding the stresses of a fault equal to that shown. Such ratings shall have been established by actual tests by the manufacturer on similar equipment construction as the subject motor control center. This test data shall be available and shall be submitted, if requested, with or before the submittal of Shop Drawings.

[SELECT THE FOLLOWING AS APPLICABLE]

H. [Circuit Breakers: Molded case circuit breakers [for autotransformer reduced voltage motor control devices and distribution devices] shall be thermal magnetic type with standard interrupting capacity, high interrupting capacity, extra high interrupting capacity, or integral current limiters as shown. Circuit breakers shall be conventional interrupting rating unless otherwise shown, but in no case less than the following values:

480 Volts Frame Size	Conventional Interrupting Capacity	High Interrupting Capacity	Extra High Integral Current Limiters
100AF 18,000 AIC	25,000 AIC	65,000 AIC	200,000 AIC
225AF 25,000 AIC	35,000 AIC	65,000 AIC	200,000 AIC
400AF 30,000 AIC	35,000 AIC	65,000 AIC	200,000 AIC
600AF 30,000 AIC	65,000 AIC	65,000 AIC	200,000 AIC
800AF 30,000 AIC	65,000 AIC	65,000 AIC	200,000 AIC]]

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR CONTROL CENTERS:

A. General: Install motor control centers where shown, in accordance with the manufacturer's written instructions and recognized industry practices to ensure that the motor control centers comply with the specified requirements and serve the intended purposes.

B. Standards: Comply with the requirements of NEMA and NEC standards and applicable portions of the NECA's "Standard of Installation", for installation of motor control centers.

C. Tightness: Torque bus connections and tighten mechanical fasteners witnessed by AHJ.

D. Fuses: Install fuses, of the ratings shown, in each motor starter, as applicable.

[SELECT WHICH ONE[

E. [Overloads: Provide solid state adjustable overload relays in each motor starter. Ratings shall be set based on actual motor nameplate full load amps.]

F. Concrete Pads: Install each motor control center on a reinforced concrete housekeeping pad. The housekeeping pad shall extend 3" beyond the housing of the motor control center, unless shown otherwise. Furnish the exact position of any block-outs, dimensions, and location of the housekeeping pads in a timely manner so as to prevent delay of the concrete work. Refer to Section 26 05 01, "Electrical Basic Materials and Methods", for additional requirements.

G. Adjustment: Adjust operating mechanisms for free mechanical movement.

H. Coordination: Motor starters shall be provided to properly coordinate with motors as furnished by Division 23. Motor starter controls shall be provided to properly coordinate with controls specified in Division 23. All HVAC or EMS controlled shall have VFO.

I. Touch-ups: Touch-up scratched or marred surfaces to match original finish.

3.2 TESTING:

A. Pre-energization Checks: Function test using continuity before energizing. Prior to energization, check motor control center for continuity of circuits and for short circuits. All starter terminations over Size O shall use Hypress lugs, no mechanical lugs. Torque witness by AHJ.

B. Motor Control Center Insulation Resistance Test: Each motor control center bus shall have its insulation resistance tested after the installation is complete, except for line and load side connections. Resistance shall be measured from phase-to-phase, phase-to-neutral (if present), and from phase-to-ground. Tests shall be made using a Biddle Megger or equivalent test instrument at a voltage of not less than 1000 volts dc with readings taken after 30 and 60 seconds of operation at Megger slip speed. Bus which does not exceed manufacturers bus insulation resistance specifications shall be repaired or replaced and retested until an acceptable resistance is obtained.

C. Operational Testing: Check each motor starter for proper operation and verify that motor overloads and interlocks operate properly.

D. Motor-starter Coordination Documentation: Provide motor-starter coordination documents including, but not limited to, the following information in the operation and maintenance manuals.

1. Motor size in horsepower.
2. Motor full load amp.
3. Motor efficiency.
4. Motor service factor.
5. Size and manufacturer catalog number of starter and thermal overloads.

E. Motor Rotation: Verify that motor rotation is correct as connected. Where rotation must be changed, reconnect phase conductors to motor leads at load side starter.

F. Submittals: Contractor shall furnish all instruments and personnel required for tests. Submit four copies of certified test results to Architect for review. Test reports shall include motor control center tested, date and time of test, test results, manufacturers bus insulation resistance specifications, relative humidity, temperature, and weather conditions.

G. Thermographic Testing: Refer to Section 26 01 25, "Electrical Testing", for thermographic testing.

3.3 IDENTIFICATION:

A. Refer to Section 26 05 53, “Identifications for Electrical Systems” for painting and nameplate requirements for all motor starters.

B. Every starter shall have an internal wiring diagram on the inside of the starter cover and shall be labeled inside the cover to indicate the type and ampacity of thermal overloads installed.

END OF SECTION 26 24 19