

SECTION 26 24 19 LOW VOLTAGE MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 SCOPE

- A. The requirements of the contract, Division 26 applies to work in this section. Motor Control Centers as specified and as shown on the contract drawings shall be furnished and installed by the contractor.

1.2 RELATED DOCUMENTS

- A. *[Related sections include the following:*
 - 1. *Section 26 29 23 – Variable-Frequency Motor Controllers*
 - 2. *Section 26 29 13.16 – Reduced Voltage Motor Controllers*
 - 3. *Section 26 36 23 – Automatic Transfer Switches*
 - 4. *Section 26 43 13 - Transient Voltage Suppression for Low-Voltage Electrical Power Circuits*
 - 5. *Section 26 09 13.xx.xx – Electrical Power Monitoring and Control*
 - 6. *Section 26 24 16 – Panelboards*
 - 7. *Section 2628 16 - Enclosed Switches and Circuit Breakers]*

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's printed product data.
- B. Documents: Submit shop drawings for approval. Documents shall include all dimensions, weights, electrical ratings, wiring diagrams and required clearances.

1.4 RELATED STANDARDS

- A. The Motor Control Center shall be manufactured and tested according to the latest applicable standards of the following agencies:
 - 1. UL 845 – Motor Control Centers
 - 2. NEMA ICS 18-2001 – Motor Control Centers
 - 3. NEMA ICS 1-2001 – Industrial Control and Systems: General Requirements
 - 4. NEMA ICS 2.3-2008 – Industrial Control and Systems: Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers
- B. *[Manufacturer Seismic Qualification: The low voltage motor control center(s) shall meet and be certified to seismic requirements specified in the [IBC 2012 International Building Code] [CBC 2013 California Building Code] [ASCE American Society of Civil Engineers 7-10].*
 - 1. *The low voltage motor control center(s) shall be complaint with IBC 2012 parameters:*
 - a. *Building Occupancy Category (as defined in Table 1.1 from ASCE 2010): [I] [II] [III] [IV]*
 - b. *Seismic Design Category: [A] [B] [C] [D]*
 - c. *Site Class: [A – Hard Rock] [B - Rock] [C – Very dense soil and soft rock] [D – Stiff soil profile] as defined in IBC 2006 Table 1613.5.2 Site Class Definitions*
 - d. *Ip – Importance Factor: [1.5 – Components must function after an earthquake for life safety purposes (Building Occupancy Code IV)] [1.25 - Buildings and structures that represent a substantial hazard to human life in the event of failure or that can cause substantial economic impact or mass disruption of day-to-day civilian life (Building Occupancy Code III)] [1.0 – Non-essential buildings. Function not life critical. (Building Occupancy Code I and II)]*

- e. *Ss – Mapped Spectral Accelerations for Short Periods at 0.2 seconds – 300%g*
- f. *Sds – 5% Damped Design Spectral Response Accelerations for Short Periods at 0.2 seconds – 2.0*
- g. *z/h – Height factor ratio: [] Note: Ratio is a calculated value equal to the floor the gear is installed on divided by 12. A 6th floor installation is a 0.5 value. A basement or ground floor installation is a 0.0 value.*

1.5 QUALITY ASSURANCE

- A. Manufacturer: For equipment required for the work of this section, provide products which are the responsibility of one manufacturer.
- B. Manufacturer shall have had produced similar electrical equipment for a minimum of 5 years.
- C. Manufacturer shall be ISO 9001; 2008 certified.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manual. One (1) copy of this document shall be provided with the equipment at the time of shipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The motor control centers shall be tiastar by Siemens or pre-approved equal. Approved manufacturers are as follows:
 - 1. SIEMENS
 - 2. []

2.2 GENERAL REQUIREMENTS

- A. STRUCTURES
 - 1. *[The enclosure shall be NEMA Type [1], [1A with gasketed doors], [2], [2-dripshield] [12], [3R non-walk-in]. Vertical sections shall be constructed with steel divider sheet assemblies formed or otherwise fabricated to eliminate open framework between adjacent sections or full-length bolted-on side sheet assemblies at the ends of the MCC(s).]*
 - 2. *[Vertical sections shall be 90" high excluding mounting sills, 20" wide and [15"] [20"] deep for front mounting of units. Where indicated that arrangement is to accommodate front & rear mounting of units, the structure depth shall not exceed 21". The width of the vertical section may be increased for special oversize units that cannot be accommodated in the standard 20" side structure.]*
 - 3. Vertical structures shall be divided into six (6) 12" space factors and shall accommodate six (6) full size NEMA size 1 or 2 Full Voltage Non Reversing FVNR combination starters. MCC unit sizes shall be multiples of 1/2 space factor (6"). The vertical structures shall accommodate 6" high density and dual mounted units.
 - 4. Back-to-back, front and rear unit mounting, structures shall be 21" deep maximum and shall accommodate 12 full size NEMA size 1 or 2 Full Voltage Non Reversing FVNR combination starters per section.
 - 5. Each standard 20" and 24" wide structure shall be supplied with a vertical wireway. 4" wide wireways shall be installed on 20" wide structures and 8" wide wireways on 24" wide structures. Wireways shall be completely isolated from all power busses. The rear surface of the vertical wireway shall be painted white. A minimum of three (3) formed wire cable supports, extending the full depth of the vertical wireway shall be supplied in each vertical section. A separate hinged door shall cover the vertical wireway.
 - 6. Each standard structure shall be supplied with a 12 inch top and six (6) inch bottom horizontal wireway that are continuous for the entire length of the MCC. The minimum

horizontal wireway opening between sections is 40 square inches for the top and 30 square inches for the bottom horizontal wireway. A hinged door shall be supplied to cover the top horizontal wireway.

7. Doors are to be hinged in a manner that allows for the removal of individual doors without the removal of any door above or below. Unit doors shall be hinged on the left and vertical wireway doors on the right for unobstructed access to the units and associated vertical wireway. All doors shall be mounted on removable pin-type hinges and secured with steel quarter-turn, indicating type fasteners.
8. Wireways shall be completely isolated from bus compartments by suitable barriers. Sliding barriers between the horizontal bus and top horizontal wireway are not acceptable.
9. Removable top cover plates shall be provided for conduit entry to the top horizontal wireway and shall provide a minimum of 116 square inches of area for conduit location. Top cover plates shall be fabricated from 13 gauge steel.
10. All MCC structures shall be supplied with 1-1/8" high X 3" wide base channel sills that are continuous for the entire length of the shipping split. The base channel sills shall be fabricated of 7 gauge steel and shall be suitable for grouting the base channel sills in place, welding to leveling plates or securing to the floor with 1/2" anchor bolts. MCC structures shall be supplied with reversible bottom end cover plates to cover the bottom horizontal wireway and ends of the base channel sills. The bottom end cover plates shall be factory installed to cover the ends of the base channel sills to prevent entrance of dirt and rodents into the MCC when installed flush on the floor and shall be removable to expose the ends of the base channel sills if they are to be grouted into the floor.
11. A removable, full length lifting angle shall be provided for each shipping split of each MCC. The lifting angle shall be bolted to each side sheet or divider sheet of the shipping split to evenly distribute the weight of the MCC during lifting.
12. MCC's shall be assembled in such a manner that it is not necessary to have rear accessibility to remove any internal devices or components.

B. BUSSING

1. ***The main horizontal bus shall be (Pick a. or b.)***
 - a. ***[[Tin] [Silver] plated copper rated at [600] [800] [1200] [1600] [2000] [2500] amperes with a conductivity rating of 100% IACS. The horizontal bus bars shall be fully sized to carry 100% of the rated current the entire length of the MCC. Horizontal bus bars shall be mounted edge wise and located at the top of the MCC. Tapered horizontal bus is not acceptable.] All power bus shall be braced to withstand a fault current of [42,000] [65,000] [100,000] RMS symmetrical amperes.]***
 - b. ***[Tin plated aluminum rated at [600] [800] [1200] amperes. All power bus shall be braced to withstand a fault current of [42,000] [65,000] RMS symmetrical amperes.]***
 - c. The entire horizontal bus assembly must be located behind the top horizontal wireway at any amperage. Horizontal bus bars located behind usable unit space are not acceptable.
 - d. The horizontal bus shall be isolated from the top horizontal wireway by a clear, flexible, polycarbonate, barrier allowing visual inspection of the horizontal bus without removing any hardware.
2. ***The vertical bus:***
 - a. ***Shall be rated [300] [600] amperes. Vertical bus bars shall be fabricated of [tin] [silver] plated solid copper bars with a conductivity rating of 100% IACS.***
 - b. ***[Pick one of the following 4; delete the other 3.] [The vertical bus assembly shall be isolated from the unit mounting space by means of a full height steel barrier. Provisions shall be made to close off unused unit stab openings in the vertical bus barrier with removable covers.]***
 - c. ***[The vertical bus assembly shall be isolated from the unit mounting space by means of a full height steel barrier. Automatic shutter mechanisms shall***

be provided to close off all unused stab openings when a plug-in unit is moved to the "TEST" position or removed from the structure. Unused stab openings shall be covered with snap-in covers.]

- d. *[The vertical bus barrier support shall be designed as to effectively enclose each vertical bus bar. Provisions shall be made to close off unused unit stab openings in the vertical bus barrier with removable covers.]*
 - e. *[The vertical bus barrier support shall be designed as to effectively enclose each vertical bus bar. Automatic shutter mechanisms shall be provided to close off all unused stab openings when a plug-in unit is moved to the "TEST" position or removed from the structure. Unused stab openings shall be covered with snap-in covers.]*
3. All bus ratings are to be based on a maximum temperature rise of **[50°C] [65°C]** over a 40°C ambient temperature.
 4. Horizontal to vertical bus and horizontal bus splice connections shall be made with two (2) 3/8" grade 5 bolts and conical washers at each connection point. All connecting hardware shall be designed to be tightened from the front of the MCC without applying any tools to the rear of the connection.
 5. The horizontal ground bus shall be rated **[300 amp copper] [600 amp copper] [600 amp aluminum]**.
 6. The neutral bus connection shall be rated **[600 amp copper] [1200 amp copper] [1600 amp copper]**.

C. UNITS

1. Plug-in units shall connect to the vertical bus by means of self-aligning, tin plated copper stab-on connectors provided with spring steel back-up springs to insure positive connection to the vertical bus.
2. When vertical ground bus is specified, plug-in units shall include a ground stab which engages the vertical ground bus before the power stabs engage the vertical bus when the unit is inserted into the structure. When the plug-in unit is withdrawn from the vertical bus, the vertical ground stab shall release after the power stabs.
3. The interior of all MCC units shall be painted white, including unit top and bottom plates or isolation barriers.
4. All plug-in units 12" tall and larger will include two (2) auxiliary handles to aid in installation, removal and transporting plug-in units.
5. All plug-in units will include a racking mechanism to assure full engagement with the stab-on connectors with the vertical bus.
6. Plug-in units shall be provided with interference mechanism type draw-out to prevent complete removal of the plug-in unit from the structure in one motion. The interference mechanism shall also provide clear indication when the plug-in unit has been withdrawn to the "TEST" position.
7. A mechanical interlock shall be supplied on all plug-in units to prevent insertion or removal of a unit from the structure when the unit operator handle is in the ON position. This interlock may not be defeated.
8. Each 12" tall and larger plug-in unit shall be secured in the structure by two (2) readily accessible devices, one of which is tool operated. These devices shall be located at the front of the unit.
9. Plug-in units with NEMA Type B or C wiring shall be supplied with unit terminal block mounted within the unit, adjacent to the vertical wireway. For non-high density units, the terminal blocks shall be mounted on a movable bracket that maintains the terminals inside the unit structure for normal operation and pivots into the vertical wireway exposing the terminals for wiring, test and maintenance.
10. All plug-in units shall include a positive means of grounding the unit to the structure at all times.
11. The MCC unit disconnect operator shall operate in a vertical, up-down, plane. 6" units shall operate in a horizontal motion. All unit disconnects shall remain engaged with the disconnect device at all times, regardless of the unit door position. The operating

handles shall be interlocked with the unit door so that the door can neither be opened with the disconnect device in the ON position, nor can the disconnect device be turned ON with the unit door open except by operation of a defeater mechanism. Indication of the disconnect device shall be clearly indicated by the position of the operating handle. When applied with circuit breaker devices, the handle shall also provide clear indication of a circuit breaker trip.

12. When pilot lights, push buttons or sector switches are specified. The devices shall be mounted in a formed metal device panel that is capable of accepting four (4) such devices in any combination. The device panel shall be secured to the unit door for normal operation, or mounted on the plug-in unit as required for unit removal and bench testing.
13. **Pilot devices [shall be 22 mm in diameter, rated for NEMA 4 (IP 67) applications. Connections to 22 mm pilot devices shall be made to touch resistant screw type terminations. Pilot device contacts shall be rated at 10A, 600 VAC (NEMA A600 Same Polarity).] [Pilot devices shall be heavy duty, oil tight 30mm devices with a NEMA 4 rating. Pilot device contacts shall be rated at 10A, 600 VAC (NEMA A600). The pilot device bodies shall be fabricated from metal.]**
14. Unit identification nameplate shall be provided for each unit. Nameplates shall be a black surface with white core. Engraving shall cut through the black surface exposing white lettering of the unit designation. Nameplates shall be 1" tall by 3 1/2" wide. Adhesives or glues are not an acceptable means of mounting unit nameplates.

D. WIRING

1. The wiring shall be NEMA Class **[1] [2]**, Type **[A] [B] [C]**.

E. COMBINATION MOTOR STARTERS

1. The combination motor starters shall be provided with a Siemens **[magnetic only circuit breaker][thermal magnetic circuit breaker][fused disconnect]**, unless noted otherwise on the drawings.
 - a. Combination Motor Starters shall be rated equal to or greater than the AIC rating of the Motor Control Center.
2. Overload Protection
 - a. The overload protection shall be:
 - 1.) **[Bi-Metal Ambient compensated overload.]**
 - 2.) **[Self power ESP solid state overload relay with NEMA Class [10] [20] [30] trip curve.]**
 - 3.) **[SIMOCODE solid state overload relay with Class 5-40 protection multifunctional, electronic full motor protection. Detailed operating, service, and diagnostics data via PROFIBUS.]**
3. Control Power
 - a. Each starter unit shall be provided with an encapsulated control power transformer of sufficient size to accommodate the contactor coil burden plus all specified auxiliary devices.

F. FEEDERS

1. Feeder disconnects shall be Siemens **[thermal-magnetic circuit breaker] [fused disconnect]**.

G. **[ARC FLASH**

1. **Labeling [OPTIONAL]**
 - a. **[Apply in the field, the factory supplied arc flash warning label to all motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized to warn qualified persons of potential electrical arc flash hazards.]**
2. **[Dynamic Arc Flash Sentry [OPTIONAL]**
 - a. **The main circuit breaker shall be a Siemens WL equipped with an ETU776 trip unit; field programmed with two trip curves. One curve shall be set to the levels determined by a coordination study. The second setting shall be**

set with instantaneous set down to a minimum acceptable level to trip the main rapidly on an arc flash event.

[Delete one or both of the next 2 items.]

- 1.) *[The settings shall be adjusted via terminals for connecting a field installed motion sensor. A blue light shall illuminate on the front of the MCC to denote when Dynamic Arc Flash Sentry is on.]*
- 2.) *[The settings shall be adjusted via a 2 position selector switch. A blue light shall illuminate on the front of the MCC to denote when Dynamic Arc Flash Sentry is on.]]*

2.3 SMART MOTOR STARTER

- A. Motor starter units shall include a microprocessor based protective and control overload that provides NEMA class 5, 10, 15, 20, 25, 30, 35 or 40 thermal trip characteristics, phase asymmetry (phase imbalance & phase loss) protection, stalled rotor protection, instantaneous over current (jam) and under current protection and provisions for connecting one thermister. Upper and lower current limits shall be adjustable for tripping and monitoring.
- B. The device shall provide an option of voltage and power monitoring as well as monitoring of power factor (cos-phi or loss of load) protection. Device shall have internal and external ground fault monitoring capabilities to an exacting 0.3 amp equipment protection. Additionally the device shall have an option of monitoring three RTD's (PT100 or PT1000) temperature sensors or three NTC thermister sensors. ***[The device shall have two analog inputs and one analog output with a [0 to 20m amp] [4 to 20m amp] signal.]***
- C. All protective functions shall be programmable to initiate a fault (trip) or warning. The device shall have the ability to designate its inputs as external fault inputs for hardwiring into upstream or downstream parts of the application. Running status of the connected load shall be determined by monitoring motor current to give a true indication of running status. The device shall provide monitoring of operating hours, downtime hours, number of starts, overload trips and have permissible starting capabilities.
- D. The device shall contain four digital inputs and three relay output points for use in controlling the motor starter. ***[There shall be two additional digital modules with 4I/2O, and they shall have [bi-stable] [mono-stable] output contacts.]*** Output relays shall be programmable to either turn off or retain their status in the event of a control voltage loss or network failure.
- E. The device shall also include on board logic elements including up to a total of six 3I/1O truth tables, two 2I/1O truth tables, and one 5I/2O truth table.
- F. The device shall have up to four signal conditioners and four non-volatile elements with adjustable (edge rising with memory, edge falling with memory, inverting and non-inverting) conditions. Additional elements shall include up to four timers with adjustable (with closing delay, closing delay with memory, with off delay, with fleeting closing) conditions and four limit monitors for overshoots and undershoots of any of its analog signals.
- G. The device shall communicate via ***[Pick one of the following 4. Delete the other 3.] [PROFIBUS-DP] [Modbus RTU] [PROFINET] [Ethernet/IP]*** to a central master controller and provide motor current, in percent of the motor full load amps, input and output data, status messages ON, OFF, under and over current warning and trip on a continuous cyclical basis.
- H. The user shall have the ability to remotely monitor and program all programmable parameters, diagnostic data and operating data.
- I. ***[Delete these next two sentences if the communication protocol is NOT PROFIBUS-DP] [The device shall communicate at a maximum of 1.5Mbit Profibus communication speed, and shall be auto baud rate sensing. The device shall be able to send 244 bytes per telegram and 64 bytes of diagnostics.]***

- J. In the event of a communication network failure or PLC failure, the device shall operate as a stand-alone device. Upon restoration of the network, the device shall resume communication with the network.

2.4 NETWORK **[If you are using an AS-interface, remove the last two sentences.]**

- A. *[The Siemens Smart Motor Control Center shall be connected to the customer's existing system via the **[Pick one of the following 4. Delete the other 3.]** **[PROFIBUS-DP]** **[Modbus RTU]** **[PROFINET]** **[Ethernet/IP]** network located in the customer's PLC. These network scanners shall provide full Profibus network connectivity.]* *[The Siemens Smart Motor Control Center shall be connected to the customer's existing system via a Network Gateway. The network gateway shall provide restricted network connectivity.]* *[The Siemens Smart Motor Control Center shall be a stand alone system.]*
- B. Siemens tiastar Smart Motor Control Center is supplied with **[Pick one of the following 5. Delete the other 4.]** **[PROFIBUS-DP]** **[AS-Interface]** **[Modbus RTU]** **[PROFINET]** **[Ethernet/IP]**. These networks shall be installed at the factory to provide simplify commissioning on site. **[Select 2.4.B.1, 2.4.B.2. 2.4.B.3 or 2.4.B.4. Delete the other sections.]**
1. **[AS-Interface]**
 - a. *AS-Interface networking shall be used for the passing of low level binary information to and from tiastar Smart Motor Control Center devices. Maximum electrical cable length is 100m with a 5ms cycle time.*
 - b. *Each AS-Interface network must consist of 1 AS-Interface Master Unit and may connect up to 31 AS-Interface module slaves located within the tiastar Smart Motor Control Center units. There may be as many AS-Interface networks as the higher level operating system can control.*
 - c. *The AS-Interface network is connected throughout the tiastar Smart MCC via a copper two wire twisted pair daisy chained from the master unit to each subsequent unit. These wires terminate into pull-apart terminals at each unit to keep network integrity if the unit is withdrawn from the vertical section.*
 - d. *The AS-Interface Master provides all AS-I network support functions and also the data transfer to Profibus DP. The AS-Interface Power Supply generates the AS-interface slave control power as well as the data decoupling feature to send both power and data over the same two wires. The AS-Interface Master Unit must contain both the Master and Power Supply. Each AS-Interface Master Unit and its connected network devices shall be considered a single Profibus DP slave within a tiastar Smart Motor Control Center.]*
 2. **[Profibus DP]**
 - a. *Profibus DP networking shall be used for the passing of binary and analog data to and from tiastar Smart Motor Control Center devices. Maximum electrical cable length 400m at 500kbps; 200m at 1.5Mbps. Distances of 3000m are possible with the use of fiber optic cable.*
 - b. *Each Profibus DP network shall connect to up to 126 nodes. The Profibus DP network may have up to 10 segments with up to 30 nodes in each. Profibus segments are connected via the Profibus Repeater. There shall be as many Profibus DP networks as the higher level operating system can control.*
 - c. *The Profibus DP network shall connect throughout the tiastar Smart MCC via copper RS485 shielded twisted two wire Profibus cable daisy chained from unit to unit. These cables terminate into Profibus connectors at each unit with a Profibus communication port. Cables terminated within the Profibus connector shall maintain network connectivity when the unit is withdrawn from the vertical section.*

- d. *Profibus repeater units shall provide data signal amplification and bus segment connection. Standard integral bus terminating resistor shall be provided through the Profibus connector. Each connector shall have a switch built in that turns the terminating resistor on and off. [OPTIONAL An active Profibus terminator shall provide consistent Profibus DP network termination that does not rely on node control power or connector switch position].]*
- 3. **[MODBUS RTU]**
 - a. *Motor Control Center assemblies shall be provided with a factory assembled Modbus RTU field bus communications network providing direct connectivity between MCC devices and the system controller and/or HMI.*
 - b. *The Modbus RTU system installed in the MCC shall include a complete and tested cabling system compliant to Modbus standard. The cabling system shall be a daisy chain using shielded twisted pair cable between each Modbus RTU device. The Modbus RTU cabling shall be 600 Volt insulation and include electrical shielding, non-standard, non-shielded cable will not be accepted.*
 - c. *Each shipping split of motor control shall allow for the Modbus RTU cable to be disconnected for shipment and then reconnected during installation.*
 - d. *Modbus RTU communications modules shall be provided at each device interfacing to the Modbus RTU field bus. The communications modules shall be installed in the unit device compartment or bucket, and shall be direct-connected to the Modbus RTU communication cable. Each device shall be provided with the appropriate factory fabricated cable for interfacing the communications module with the associated Modbus RTU device.*
- 4. **[Ethernet [Pick one of the following; delete the other.] [PROFINET] [Ethernet/IP]**
 - a. *Motor Control Center assemblies shall be provided with a factory assembled Ethernet communications network providing direct connectivity between MCC devices and the system controller and/or HMI.*
 - b. *Ethernet 10/100 auto negotiate layer 2 managed industrial switches shall be provided as required in the MCC lineup. The Ethernet switch shall have sufficient ports available to connect to each EtherNet/IP device and have at least 2 open ports for a customer connection and a PC connection for maintenance. The Ethernet switch shall be mounted in the top removable unit of the vertical section or shipping split and not in the vertical wireway. If required by the application, the switch shall be capable of connecting to multiple sections.*
 - c. *The Ethernet system installed in the MCC shall include a complete and tested cabling system. The cabling system shall be 600V Cat 5 and consist of home run connections from the device to a switch located in the MCC.*
 - d. *It shall be permissible to daisy chain Ethernet/IP devices using a 2-port switch configuration in each device unit or bucket and not use the home run topology.*
 - e. *Ethernet communications modules shall be provided at each device interfacing to the Ethernet network. The communications modules shall be installed in the unit device compartment or bucket, and shall be direct-connected to the Ethernet cable. Each device shall be provided with the appropriate factory fabricated cable for interfacing the communications module with the associated EtherNet/IP device.*
 - f. *Switches must be made by the Motor Control Center manufacturing company. In addition, the placement of the diagnostic LEDs shall make them visible even when all ports have cables inserted. Manufacture shall provide 10 year support of the switch after discontinuation.*

2.5 METERING

- A. *Multifunction digital-metering monitors shall be, microprocessor-based unit suitable for three or four wire systems. Units shall communicate via:*
 - 1. *[Profibus DP module] SIEMENS Preferred method.*
 - 2. *[ModBus TCP port]*
 - 3. *[ModBus RTU expansion module].*
- B. *The meter shall mounted on the door and shall meter [at the Main Lugs] [at the Main Breaker] [as shown on the drawings].*
- C. *[Metering Equipment]*
 - 1. *Provide a multi-function, high accuracy digital power metering instrumentation module equipped with LCD display. The power metering module shall provide simultaneous measurements for current, voltage and power parameters. Power meter shall be Siemens type [PAC 3100] [PAC 3200] [PAC4200] [9410] equipped with a communications port for standard RS-485 connection.*

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be per the manufacturer's recommendations, written instructions, final shop drawings, and contract documents. Installation shall be coordinated with adjacent work to ensure proper sequence of construction, clearances and support.
- B. The Motor Control Center shall not be placed in hazardous locations. The location shall be well ventilated and free from humidity, dust, and dirt. The temperature shall be no less than 32°F and no greater than 104°F. Protection shall be provided to prevent moisture from entering the enclosure.

3.2 TESTING

- A. Perform factory and installation tests in accordance with applicable NEMA and UL requirements.

3.3 WARRANTY

- A. Equipment manufacturer warrants that all goods supplied shall be free of non-conformities in workmanship and materials for one year from date of initial operation, and not more than eighteen months from date of shipment.

END OF SECTION