SECTION 16482
MOTOR CONTROL CENTERS

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install the motor control centers as specified herein and as shown on the contract drawings.

1.02 RELATED SECTIONS

A. Section 16475 – Circuit Breakers and Fusible Switches

B. Section 16481 – Par. 2.03 – Freedom Electro-Mechanical Motor Control

C. Section 16481 – Par. 2.04 – Advantage Microprocessor Motor Control

D. Section 16481 – Par. 2.05 – Solid-State Reduced Voltage Motor Control

E. Section 16483 – Adjustable Frequency Drives

F. Section 16671 – Transient Voltage Surge Suppression

G. Section 16901 – Microprocessor Metering Equipment

H. Section 16902 – Electric Control Devices

I. Section 16903 – Protective Relays

J. Section 16905 – Programmable Controllers

K. Section 16911 – Electrical Monitoring and Control Systems

1.03 REFERENCES

A. The Motor Control Centers and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA, ANSI and UL 845.

1.04 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. Master drawing index
2. Front view elevation
3. Floor plan
4. Top view
5. Single line
6. Unit wiring diagrams depicting remote devices
7. Nameplate schedule
8. Starter and component schedule
9. Conduit entry/exit locations
10. Assembly ratings including:
    a. Short-circuit rating

b. Voltage
c. Continuous current

11. Major component ratings including:
    a. Voltage
    b. Continuous current
    c. Interrupting ratings
12. Cable terminal sizes
13. Product data sheets.

B. Where applicable the following information shall be submitted to the Engineer:
    1. Busway connection
    2. Connection details between close-coupled assemblies
    3. Composite floor plan of close-coupled assemblies
    4. Key interlock scheme drawing and sequence of operations.

1.05 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:
    1. Final as-built drawings and information for items listed in paragraph 1.04
    2. Unit wiring diagrams
    3. Certified production test reports
    4. Installation information
    5. Seismic certification and equipment anchorage details.

B. The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

1.06 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of Uniform Building Code (UBC) for Zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, UBC: a peak of 2.15g's (3.2–11 Hz), and a ZPA of 0.86g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.

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D. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC) through Zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, CBC: a peak of 2.15g's, and a ZPA of 0.86g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.

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D. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the BOCA National Building Code, paragraph 1612.6. This shall include both vertical and lateral required response spectra as specified. Alternatively, the manufacturer's certification may be based on a detailed computer analysis of the entire assembly structure and its components. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. The test response spectra shall meet or exceed the required response spectra peak acceleration of 1.6g's (3.2–11 Hz) and a ZPA of 1.0g as specified in the BOCA National Building Code, for all equipment natural frequencies up to at least 35 Hz.

E. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
3. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.07 REGULATORY REQUIREMENTS

A. The motor control centers shall bear a UL label. ✂[Certified copies of production test reports shall be supplied demonstrating compliance with these standards when requested by the Engineer.]

1.08 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.09 OPERATION AND MAINTENANCE MANUALS

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A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cutler-Hammer

B. ✎_____

C. ✎_____

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 RATINGS

A. The Motor Control Center(s) shall be 600-volt class suitable for operation on a three-phase, 60-hertz system. The system operating voltage and number of wires shall be as indicated on the drawings.

2.03 CONSTRUCTION

A. Motor Control Center(s) shall be Cutler-Hammer type ☛[F2100] [Advantage] design.

B. Structures shall be totally enclosed deadfront, free-standing assemblies. They shall be 90 inches high and ☛[16 inches] [21 inches] deep for front-mounted units. Structures shall contain a horizontal wireway at the top, isolated from the horizontal bus and shall be readily accessible through a hinged cover. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference.

C. Compartments for mounting control units shall be incrementally arranged such that not more than ☛[six (6) size 1 starters for front-mounted only] [eleven (11) size 1 starters for back-to-back] can be mounted within each vertical structure. Guide rails shall be provided.

D. A vertical wireway with minimum of 35 square inches of cross-sectional area shall be adjacent to each vertical unit and shall be covered by a hinged door. Wireways shall contain steel rod cable supports.

E. All full voltage starter units through NEMA Size 5 shall be of the drawout type. Drawout provisions shall include a positive guide rail system and stab shrouds to absolutely ensure alignment of stabs with the vertical bus. Draw-out units shall have a tin-plated stab assembly for connection to the vertical bus. No wiring to these stabs shall extend into the bus compartment. Interior of all units shall be painted white for increased visibility. Units shall be equipped with side-mounted, positive latch pull-apart type control terminal blocks rated 600 volts. Knockouts shall be provided for the addition of future terminal blocks. In addition, a

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master terminal block, when Type C wiring is specified, shall be drawout and shall be located in the ☛[top] [bottom] wireway, readily accessible through a hinged cover. All control wire to be ☛[14 gauge] [16 gauge] minimum.

F. All drawout units shall be secured by a spring-loaded quarter turn indicating type fastening device located at the top front of the unit. Each unit compartment shall be provided with an individual front door.

G. An operating mechanism shall be mounted on the primary disconnect of each starter unit. It shall be mechanically interlocked with the unit door to prevent access unless the disconnect is in the OFF position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect. A second interlock shall be provided to prevent removal or re-insertion of the unit while in the ON position. Padlocking facilities shall be provided to positively lock the disconnect in the OFF position with from one (1) to three (3) padlocks with the door open or closed. In addition, means shall be provided to padlock the unit in a partially withdrawn position with the stabs free of the vertical bus.

2.04 BUS

A. Each structure shall contain a main horizontal ☛[copper tin-plated] [copper silver-plated] bus, with minimum ampacity of 600 amperes or rated ☛[800] [1200] [1400] [1600] [2000] [2500] [3200] amperes as shown on the drawings. The horizontal bus shall be rated at ☛[65] [50] degrees C temperature rise over a 40 degree C ambient in compliance with UL standards. Vertical bus feeding unit compartments shall be copper and shall be securely bolted to the horizontal main bus. All joints shall be front- accessible for ease of maintenance. The vertical bus shall have a minimum rating of 300 amperes for front-mounted units and 600 amperes for back-to-back mounted units or fully rated ☛[600] [800] [1200] amperes.

B. For ☛[F2100] [Advantage] design MCC, the vertical bus shall be completely isolated and insulated by means of a labyrinth design barrier. It shall effectively isolate the vertical buses to prevent any fault-generated gases to pass from one phase to another. The vertical bus shall include a shutter mechanism to provide complete isolation of the vertical bus when a unit is removed.

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B. For F2100 design MCC, isolation of the vertical bus compartment from the unit compartment shall be by means of a full height insulating barrier. This barrier shall be a single sheet of glass reinforced polyester with cutouts to allow the unit stabs to engage the vertical bus. Provide snap-in covers for all unused openings.

C. Buses shall be braced for ☛[65,000] [100,000] amperes RMS symmetrical.

2.05 WIRING/TERMINATIONS

A. Wiring shall be NEMA Class ☛[I] [II], Type ☛[A] [B] [C].

B. ✂DeviceNet Wiring shall be in accordance with the Open DeviceNet Vendors Association (ODVA) specification. Truck cable shall be provided in the upper wireway, with T connectors for each MCC section. Drop cables and T connectors shall be used in the vertical wireway to connect each DeviceNet device.

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2.06 MOTOR CONTROLLERS

Note to Spec. Writer:
Two classes of combination motor starters are outlined below. Select one of the paragraphs 2.06 A. The first paragraph is for circuit breaker type combination starters; the second paragraph is for fusible type starters combination starters. Three types of motor starter (contactor/ overload) are available. Select one of the of paragraphs 2.06 B. The first paragraph is for Advantage Microprocessor Motor Starters; the second paragraph is for DeviceNet Compatible Motor Controllers; the third paragraph is for Freedom Series NEMA Electromechanical Motor Starters for F2100 MCC

A. Combination starter units shall be full-voltage non-reversing, unless otherwise shown, and shall utilize Cutler-Hammer type HMCP Motor Circuit Protectors.

1. Each combination unit shall be rated ☛[65,000] [100,000] AIC symmetrical at 480V. The HMCP shall provide adjustable magnetic protection and be provided with pin insert to limit magnetic adjustment to a maximum of 1700% motor nameplate full load current to comply with NEC requirements. All HMCP combination starter units shall have a “tripped” position on the unit disconnect and a push-to-test button on the HMCP. Type HMCP motor circuit protectors shall include transient override feature for motor inrush current. ✂[HMCP shall be used to provide IEC 947-4 Type 2 coordination to 100,000 amperes.]

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A. Combination starter units shall be full-voltage non-reversing, unless shown otherwise utilizing fusible switches.

1. Fusible switches shall be quick-make, quick-break and shall accept class R dimension fuses and the combination shall safely interrupt 100,000 amperes. Fusible combination starters shall provide IEC 947-4 Type 2 coordination to 100,000 amperes.

B. Motor starters shall be Cutler-Hammer type Advantage, electrically operated, electrically held, three-pole assemblies with arc extinguishing characteristics and shall have silver-to-silver renewable contacts. They shall have provisions for a total of eight (8) NO or eight (8) NC auxiliary contacts. The overload protection shall consist of one (1) current sensor located in each phase monitored by the microprocessor that yields a time-current curve closely paralleling that of motor heating damage boundary, accurate to 2%. Running overload protection shall be DIP switch selectable for the specific motor full load amperes within the starter range. Provide DIP switch selectable overload trip class of 10, 20 and 30.

1. Motor starters shall monitor current in each phase to provide phase loss and phase unbalance protection, such that if the unbalance on any of two phases is greater than 30% of the DIP switch selected trip rating, a phase loss/unbalance trip occurs. Provide phase loss/unbalance protection which requires no time delay for reset.
2. Motor starters shall provide ground fault protection. Ground fault protection shall be set at 20% of maximum continuous ampere rating and have a start delay of 20 seconds, and a run delay of 1 second to prevent nuisance trip on starting.
3. Microprocessor shall measure control circuit voltage and prevent closing of the coil on low-voltage (78 volts AC) and/or high-voltage (135 volts AC) conditions which are outside of the coil ratings.
4. Microprocessor shall apply voltage to the coil such that a guaranteed maximum of two (2) milliseconds of main contact bounce occurs on contactor closure.

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5. Microprocessor shall continuously measure coil circuit voltage and current so as to maintain constant coil power at a level to maintain main contact closure and minimize coil power consumption.
6. Provide control modules to perform the indicated input/output control functions shown on the drawings. Module to incorporate faceplates having membrane type pushbuttons and LEDs. All pushbutton and LED functions to be furnished with clearly written identification. Modules to be provided with the ability to replace conventional start, stop, hand, auto, and control functions, and when utilized in starter applications, overload reset function. Modules to be provided with the ability to replace conventional indicating light status of run, off, selector switch pushbutton position, and when utilized in starter applications, overload alarm and overload trip.
7. Provide, where indicated on the drawings, a metering module capable of displaying control voltage, status and where utilized on starter applications, cause of trip, current at time of trip and current in each phase.
8. ☛[Provide] [Make provisions for] an addressable communication card capable of transmitting all data over a compatible two-wire local area network to a central personal computer for storage and/or printout. The network shall also be capable of transmitting data in RS232c format via a translator module.
    a. ON-OFF reset control functions
    b. Status (ON, OFF, TRIPPED, NO RESPONSE)
    c. Current in each phase
    d. Percent phase unbalance
    e. Control voltage
    f. Overload protection settings
    g. Cause of trip
    h. Trip current magnitude

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B. Motor starters shall be DeviceNet compatible, Cutler-Hammer type Advantage, electrically operated, electrically held, three-pole assemblies with arc extinguishing characteristics and shall have silver-to-silver renewable contacts. They shall have provisions for a total of eight (8) NO or eight (8) NC auxiliary contacts. The overload protection shall consist of one (1) current sensor located in each phase monitored by the microprocessor that yields a time-current curve closely paralleling that of motor heating damage boundary, accurate to 2%. Running overload protection shall be DIP switch selectable for the specific motor full load amperes within the starter range. Provide DIP switch selectable overload trip class of 10, 20 and 30.
    1. Motor starters shall monitor current in each phase to provide phase loss and phase unbalance protection, such that if the unbalance on any of two phases is greater than 30% of the DIP switch selected trip rating, a phase loss/unbalance trip occurs. Provide phase loss/unbalance protection which requires no time delay for reset. Phase unbalance protection shall have the capability of being deactivated by use of a hand-held programmer.
    2. Motor starters shall provide ground fault protection. Ground fault protection shall be set at 20% of maximum continuous ampere rating and have a start delay of 20 seconds, and a

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run delay of 1 second to prevent nuisance trip on starting. Ground fault protection shall have the capability of being deactivated by use of a hand-held programmer.

3. Microprocessor shall measure control circuit voltage and prevent closing of the coil on low-voltage (78 volts AC) and/or high-voltage (135 volts AC) conditions which are outside of the coil ratings.
4. Microprocessor shall apply voltage to the coil such that a guaranteed maximum of two (2) milliseconds of main contact bounce occurs on contactor closure.
5. Microprocessor shall continuously measure coil circuit voltage and current so as to maintain constant coil power at a level to maintain main contact closure and minimize coil power consumption.
6. Provide control modules to perform the indicated input/output control functions shown on the drawings. Module to incorporate faceplates having membrane type pushbuttons and LEDs. All pushbutton and LED functions to be furnished with clearly written identification. Modules to be provided with the ability to replace conventional start, stop, hand, auto, and control functions, and when utilized in starter applications, overload reset function. Modules to be provided with the ability to replace conventional indicating light status of run, off, selector switch pushbutton position, and when utilized in starter applications, overload alarm and overload trip.
7. Provide, where indicated on the drawings, a metering module capable of displaying control voltage, status and where utilized on starter applications, cause of trip, current at time of trip and current in each phase.
8. Each Starter shall have an addressable communication card capable of transmitting control and diagnostic data over an open DeviceNet network to either a personal computer or PLC. The addition of the DeviceNet communication module shall not increase the size of the controller. The starter shall be capable of transmitting the following data.
   a. ON-OFF reset control functions
   b. Status (ON, OFF, TRIPPED, NO RESPONSE)
   c. Current in each phase
   d. Percent phase unbalance
   e. Control voltage
   f. Overload protection settings
   g. Trip current magnitude
   h. Average motor current
   i. Hand/Manual/Local control
   j. Cause of trip indication
      1. Phase loss
      2. Phase unbalance
      3. Ground fault
      4. Thermal trip

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B. Motor starters shall be Cutler-Hammer Freedom Series NEMA type electrically operated, electrically held, three-pole assemblies with arc extinguishing characteristics and shall have

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silver-to-silver renewable contacts. They shall have provisions for a total of eight (8) NO or eight (8) NC auxiliary contacts. The overload relay assembly shall be of the thermal bimetallic ambient compensated type. Overload relays shall be reset from outside the enclosure by means of an insulated button. The overload relay shall have a built-in push-to-test button, electrically isolated NO-NC contacts and single-phase sensitivity.

C. Each starter shall be equipped with a fused control power transformer, two (2) indicating lights, HOA selector switch, and two (2) NO contacts, unless otherwise scheduled on the drawings. Device panel to have space to accommodate six (6) oil-tight pilot-control devices or indicating ammeters, voltmeters, or elapsed time meters.

D. Solid-state reduced-voltage starters, Cutler-Hammer type S801 shall be provided where shown on the contract drawings. The solid-state reduced-voltage starter shall be UL and CSA listed in the motor control center, and consist of an SCR-based power section, logic board and paralleling bypass contactor. The paralleling bypass contactor shall be energized when the motor reaches full speed. Heat sinks shall not be allowed in the MCC structure. Each starter shall have an addressable communication card capable of transmitting control and diagnostic data over an open DeviceNet network to either a personal computer or PLC.

Note to Spec. Writer:
For more detailed specification information refer to section 16481, paragraph 2.05.

E. Adjustable frequency controllers shall be provided in MCC(s) where scheduled. Controllers shall be Cutler-Hammer type AF91 and/or SV9000 for variable torque loads unless otherwise indicated on the drawings. Controllers for variable torque loads shall be rated a minimum of 110% overcurrent for one (1) minute. Drives larger than ☛[1 hp] [10 hp] shall have identical keypads, control terminals and programmable parameters. Drives shall be capable of providing 200% starting torque. Drives over 150 hp shall be located next to the main section to reduce bus loading and heating. All controllers shall be combination type and shall include options as specified. Drives shall have communication cards capable of communication using ☛[DeviceNet] [Profibus] [LonWorks] [Modbus RTU] [Interbus S] [SDS]. Drives shall be capable of using a V/Hz, open loop vector, or closed loop vector control architecture.

Note to Spec. Writer:
For more detailed specification information refer to section 16483, paragraph 2.02.

Note to Spec. Writer:
Select paragraph 2.06 F as optional choice on Advantage MCC only

F. ✂Advantage Central Monitoring Unit (CMU)

1. Where shown on the drawing, provide a Cutler-Hammer type Advantage Central Monitoring Unit (CMU) or approved equal. The CMU shall be a microprocessor-based, self-contained device (NEMA 3R/12 faceplate) suitable for door mounting and shall perform the following listed functions. Each assembly shall have provisions for a communications module to provide for remote computer monitoring up to 10,000 feet.
2. Monitoring and display parameters of up to 99 Cutler-Hammer type Advantage starters or contactors equipped with product operated network interface card (PONI), or Cutler-

☛ Note to Spec. Writer – Select one
✂ Note to Spec. Writer – Optional

Hammer type IQ 500 solid-state overload relays. Communications over the local area network shall be 9,600 baud. Parameters locally displayed at the CMU for each starter and overload relay shall also be capable of being communicated via twisted pair to a remote personal computer. Information displayed at the CMU shall include the following:

a. Status -- ON, OFF, TRIPPED, NO RESPONSE
b. Standard address
c. Three-phase current
d. Control voltage
e. Overload condition (alarm)
f. Cause of device trip
g. Operations count
h. Run time
i. Set points
j. Starter description and identification.

3. When used with the remote communications option, the CMU shall pass data to a computer from Advantage starters, contactors and overload relays (IQ 500). The master or the host network's baud rate (speed of upper network passing data to a computer) shall be independent of the CMU's subnetwork baud rate. The master or host network's baud rate shall be established via the PONI communications module while the CMU's subnetwork baud rate shall be switch selectable on the rear of the CMU.
4. The program directing the functions or the CMU shall be permanently stored in the CMU. There shall be no need to reload data after AC power loss.
5. The addresses, types of devices and descriptions shall be stored in memory during the learn mode and shall also be retained throughout a power loss. Unless there has been a change, it shall not be necessary to re-enter the learn mode after a power loss.
6. The CMU shall have an 8-digit alphanumeric display to monitor active data, trip data or set points which are available from the individual motor control devices. The CMU shall have three (3) LEDs to indicate which group of data is being displayed, as selected through membrane-type alphanumeric pushbuttons by the user. The CMU shall have a 2-digit alphanumeric display to indicate the address of the control device for which data is being displayed. The CMU shall have membrane type pushbuttons to allow the user to step up or down to select the control device to be displayed. The CMU shall have two (2) additional LEDs at the top of the CMU to indicate that the CMU is operational and when there is an "alarm" status on one of the motor control devices. The CMU shall have an "acknowledge/reset" membrane-type pushbutton to permit the user to reset the CMU following a motor control device trip.
7. The CMU shall be operated from 120-volt, single-phase input.
8. The CMU shall have a "Help" button function, which shall scroll English explanations in the alphanumeric window for any condition or abbreviations.
9. ☛[Provide] [Make provisions for] an addressable communication card capable of transmitting all data, including trip data over a compatible two-wire, local area network to a central personal computer for storage and or printout. Provide data and time-stamping for all starter/contactor operations. Reprogramming of the CMU shall not be required when adding a communication module. The network shall also be capable of transmitting data in RS232c format via a translator module.

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2.07 OVERCURRENT DEVICES

A. Circuit Breakers

1. Individual feeder breakers shall have a minimum interrupting capacity of ☛[65] [100] kAIC at rated voltage or as scheduled on the drawings.

B. Fusible Switches

1. Individual feeder switches shall be quick-make, quick-break gang-operated type utilizing class R fuse clips. The fused switch shall be rated 100 kAIC at rated voltage.

2.08 ✂DEVICENET DEVICES

A. Motor Control Center assemblies shall be provided with a factory assembled DeviceNet fieldbus communications network providing direct connectivity between MCC devices and the system controller and/or HMI.

B. The DeviceNet system installed in the MCC shall include a complete and tested cabling system compliant and approved by the ODVA DeviceNet standard. The cabling system shall consist of trunk and drop line cabling including all splice and tap connectors and terminating resistors. The trunk and drop cabling shall be 600V insulation and include electrical shielding as per the standard ODVA DeviceNet specification. Non-standard, non-shielded flat cable will not be accepted.

C. The trunk line shall be installed in the top horizontal wireway of the MCC. The trunk line shall be thick cable as specified by the ODVA standard. Sealed, threaded, and keyed device tap connectors located and mounted in the top horizontal wireway shall “T” off the top wireway to drop cable mounted in each of the vertical wireways. Each Devicenet device shall have a dedicated drop line connection via T Connector. The drop cable shall be thin cable as specified by the ODVA standard. Each section of motor control shall be connected with sealed, threaded, and keyed device tap connectors located and mounted in the top horizontal wireway All cabling shall be securely supported and attached to the MCC structure in accordance with the contract drawings and the manufacturer’s recommendations.

D. DeviceNet communications modules shall be provided at each device interfacing to the DeviceNet fieldbus. The communications modules shall be installed in the unit device compartment or bucket, and shall be direct-connected to the DeviceNet drop cable. Each device shall be provided with the appropriate factory fabricated cable for interfacing the communications module with the associated DeviceNet device.

E. Port expanders shall be provided where required to permit multiple device communications. The port expander shall be installed in the associated unit device compartment.

F. Motor control centers shall provide required 24 volt DC power to adequately supply power to all the devices in the ☛[MCC] [Total System], and shall be sized as shown in drawings. The power supply shall be installed in an MCC unit with a disconnect switch, supplementary protection and a cable tap box to prevent damage to/from other power supplies on the network.

G. Operator interface unit(s) shall be PanelMate Power Series. Operator interface units shall be able to provide the following. Starter status, three-phase current, control voltage, overload condition (alarm), cause of device trip, operations count, run time, set points, starter

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description and identification, system process graphics screens. Operator interface shall have the capability of communicating on the DeviceNet network.

H. Industrial PC units shall be Cutler-Hammer type D700. The iPC shall have a ✎___ MHz processor, ✎___Mb DRAM, ✎____ Gb hard drive, a 3.5-inch floppy drive, and a TFT color flat screen display. The iPC shall be capable of accepting an additional ☛[2 full size] [4 half size] [5 full size] [ISA] and/or ☛[PCI] cards. The iPC shall have DeviceNet scanner card(s) capable of controlling the entire ☛[MCC] [DeviceNet System]. The iPC shall be capable of running all of the software required to configure and run the entire ☛[MCC] [DeviceNet System]. The iPC shall be preloaded with the following software:

1. Windows NT 4.0
2. ✎_____

2.09 MISCELLANEOUS DEVICES

2.10 INCOMING FEEDER TERMINATIONS AND DEVICE

A. Incoming ☛[cable] [busway] shall terminate within the control center on a ☛[main lug] [main breaker] termination point. Main lug terminations shall have adequate dedicated space for the type and size of cable used and the lugs shall be ☛[standard mechanical screw] [compression-type] with antiturn feature. Main breakers shall be provided as indicated on the drawings and shall be ☛[molded case] [insulated case, stored energy device] [air power circuit breakers].

2.11 CUSTOMER METERING

A. Where indicated on the drawings, provide a separate customer metering compartment with front hinged door.

B. Provide current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.

C. Provide ☛[potential transformers including primary and secondary fuses with disconnecting means] [fused potential taps as the potential source] for metering as shown on the drawings.

***Note to Spec. Writer:**
Select devices as required for paragraph 2.11 D.
Refer to section 16901 for detailed specification for metering.
IQ Analyzer Series (Section 16901, paragraph 2.02 A.)
IQ DP-4000 Series (Section 16901, paragraph 2.02 B.)
IQ 300 Series (Section 16901, paragraph 2.02 C.)
IQ 200 Series (Section 16901, paragraph 2.02 D.)
IQ Generator (Section 16901, paragraph 2.02 E.)
IQ Data (Section 16901, paragraph 2.02 F.)

D. Microprocessor-Based Metering System

2.12 ENCLOSURES

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A. The type of enclosure shall be in accordance with NEMA standards for ☛[type 1A with gasketed doors] [type 12 dust-tight and drip-proof] [type 3R non-walk-in] [type 3R walk-in]. All enclosing sheet steel, wireways and unit doors shall be gasketed.

2.13 NAMEPLATES

A. Each unit will have a 1.0 x 2.5-inch engraved nameplate. The lettering shall be black 3/16-inch high, on a white background.

2.14 FINISH

A. The control center shall be given a phosphatizing pretreatment. The paint coating shall be a polyester urethane, thermosetting powder paint. Manufacturer's standard color shall be used.

B. The control center finish shall pass 600 hours of corrosion-resistance testing per ASTM B 117.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. The motor control centers shall have been tested in a high-power laboratory to prove adequate mechanical and electrical capabilities.

B. All factory tests required by the latest ANSI, NEMA and UL standards shall be performed.

C. A certified test report of all standard production tests shall be available to the Engineer upon request.

D. Factory tests as outlined above shall be witnessed by the owner's representative.

1. The manufacturer shall notify the owner two (2) weeks prior to the date the tests are to be performed.
2. The manufacturer shall include the cost of transportation and lodging for up to three (3) owner's representatives. The cost of meals and incidental expenses shall be the owner's responsibility.

3.02 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and startup of the equipment specified under this section for a period of ✎_____ working days. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative:

1. Rig the MCC assembly into final location and install on level surface.
2. Check all removable cells and starter units for easy removal and insertion.

☛ Note to Spec. Writer – Select one

✎ Note to Spec. Writer – Insert data in blanks

3. Perform insulation tests on each phase and verify low-resistance ground connection on ground bus.
4. Connect all power wiring and control wiring and verify basic operation of each starter from control power source.
5. Torque all bolted connections made in the field and verify all factory bolted connections.
6. Calibrate any solid-state metering or control relays for their intended purpose and make written notations of adjustments on record drawings. Perform startup of any solid-state starters and adjustable frequency drives.

C. The Contractor shall provide three (3) copies of the manufacturer's field startup report.

3.03 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations. Equipment shall be inspected prior to the generation of any reports.

B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

3.04 TRAINING

A. The Contractor shall provide a training session for up to five (5) owner's representatives for ✎_____ normal workdays at the jobsite or other office location chosen by the owner.

B. The training session shall be conducted by a manufacturer's qualified representative.

C. The training program shall consist of the following:

1. Review of the MCC one-line drawings and schedules
2. Review of the factory record shop drawings and placement of the various cells
3. Review of each type of starter cell, components within, control, and power wiring
4. Review contactor coil replacement and contact replacement procedures.
5. Discuss the maintenance timetable and procedures to be followed in an ongoing maintenance program.
6. Provide three-ring binders to participants complete with copies of drawings and other course material covered.

3.05 EXAMINATION

A. Installing Contractor to fully inspect shipments for damage and report damage to manufacturer and file claim upon shipper, if necessary.

B. Overload relay heater ratings must be properly sized and coordinated for each motor starter unit.

C. Installing Contractor to verify NEC clearances as dictated on the contract drawings prior to installation. Verify UL labeling of the assembly prior to installation.

3.06 INSTALLATION

A. Contractor to follow the installation instructions supplied by the manufacturer.

✎ Note to Spec. Writer – Insert data in blanks

B. Control wiring shall be as shown on the contract drawings except as modified by the approval and submittal process. Interface all local and remote devices into the control wiring and operational systems for each load.

C. ✄As Shown on the contract drawing, provide DeviceNet trunk and drop cabling with threaded, sealed and keyed device taps.

3.07 FIELD ADJUSTMENTS

A. Follow the manufacturer's instructions and the contract documents concerning any short-circuit device settings, heater selection, timing relays, or startup of components.

3.08 FIELD TESTING

A. Follow the minimum requirements as stipulated in the NETA testing procedure for this type of motor control center assembly.

B. Generate a field report on tests performed, test values experienced, etc., and make available to owner upon request.

✄ Note to Spec. Writer – Optional