

SECTION 16954

MOTOR CONTROL CENTER REPLACEMENT UNITS

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install the motor control center replacement units as specified herein and as shown on the contract drawings.

1.02 RELATED SECTIONS

1.03 REFERENCES

- A. The Motor Control Center replacement units 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 – show existing MCC space and size of new MCC buckets.
 - 3. Unit wiring diagrams depicting remote devices
 - 4. Nameplate schedule
 - 5. Starter and component schedule
 - 6. Assembly ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
 - 7. Major component ratings including:
 - a. Voltage
 - b. Continuous current
 - c. Interrupting ratings
 - 8. Cable terminal sizes
 - 9. Product data sheets

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, and shall incorporate all changes made during the manufacturing process
 - 2. Unit wiring diagrams

3. Certified production test reports
4. Installation information

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. *Provide Seismic tested equipment as follows:

1. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the International Building Code (IBC) 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, IBC: a peak of 2.45g's (3.2-11 Hz), and a ZPA of 0.98g'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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1. 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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1. The manufacturer may certify the equipment 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
2. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
 - a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in

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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.

- b. 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.
- c. 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 and replacement units shall bear a UL label. Installation of the replacement units shall not void the UL label of the assembly. The General Order number on the UL label shall be visible, unaltered, as to indicate that is new and not a greymarket bucket. 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

- 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. Eaton / Cutler-Hammer products
- B. * _____
- C. * _____

Alternate bids for products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) working days prior to bid date.

2.02 RATINGS

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

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2.03 CONSTRUCTION

- A. Motor Control Center replacement units shall be manufactured by Eaton Corporation / Cutler-Hammer products for installation in an Eaton, Cutler-Hammer or Westinghouse MCC.
- B. Units must fit into existing spaces. Field verification of existing space vs. replacement breaker is required. Replacement units shall be newly constructed, not refurbished reused buckets. Bucket controls shall match existing size, type and function, ex., 30 mm, LED, push to test. Buckets shall be supplied by local sales office of original MCC manufacturer to ensure interface to existing MCC is correct, with adequate capacity and fault withstand.
- C. All full voltage starter units through NEMA Size 5 and Feeders through 400 amperes 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. Drawout units shall have a tin-plated stab assembly for connection to the vertical bus. No wiring to these stabs shall extend into the unit 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 300 volts. Knockouts shall be provided for the addition of future terminal blocks. All control wire to be 16 gauge minimum.
- D. All drawout units shall be secured by a quarter-turn indicating type fastening device located at the top left of the unit. Each unit compartment shall be provided with an individual front door.
- E. 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 reinsertion 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.

2.04 WIRING/TERMINATIONS

- A. Wiring shall be NEMA Class I, Type B.

2.05 MOTOR CONTROLLERS

- 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 480 V. The HMCP shall provide adjustable magnetic protection 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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Note to Spec. Writer:

Two classes of motor starters are outlined below.

Select the first Paragraph 2.06 B. for Advantage Microprocessor-Based motor starters

Select the second Paragraph 2.06 B. for Freedom Series NEMA electromechanical motor starters for F2100 MCC.

B. Motor Starters – Advantage Design

1. Provide motor starters of the electromechanical type with the coil controlled by an application-specific microprocessor
2. Provide one (1) current sensor accurate to 2% for each phase to provide motor running overload protection that yields a time-current curve closely paralleling that of the respective motor heating damage boundary. Running overload protection shall be DIP switch selectable for the specific motor full load amperes
3. Provide DIP switch selectable overload trip class of 10, 20 and 30
4. Provide phase loss protection and phase unbalance protection. If the phase unbalance on any of two phases is greater than 30% of the DIP switch selected trip rating, a phase loss/unbalance trip occurs
5. Provide ground fault protection set at 20% of maximum continuous ampere rating with a start delay of 17 seconds, and a run delay of 0.4 seconds to prevent nuisance tripping on startup
6. Provide each motor starter with a snap-in window which allows clear visibility of overload DIP switch settings and prevents unwanted tampering of DIP switch settings once installed
7. Provide an application-specific microprocessor with the following features:
 - a. Microprocessor shall measure control circuit voltage and prevent closing of the coil on voltages below 78 Vac and/or voltages above 135 Vac.
 - b. Microprocessor shall apply voltage to the coil such that a guaranteed maximum of two (2) milliseconds of main contact bounce occurs on contactor closure.
 - c. 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.
 - d. Provide electronic circuitry that isolates the coil and is isolated from surges.
 - e. Microprocessor shall wait for three (3) half-cycles of control start signal prior to activating a close to prevent starts resulting from momentary voltage spikes, switching transients, fluttering contacts, and shorted programmable logic control outputs. The phase angle of the power in the control circuit is to be compared with the phase angle of the input start signal to prevent starts resulting from capacitively coupled or inductively coupled signals.
8. Motor starters shall have replaceable fixed and movable contacts
9. Accessories:
 - a. Motor starter shall be designed to accommodate two (2) auxiliary contact blocks, each capable of a combination of up to four (4) normally closed or four (4) normally open auxiliary contacts. Contacts to be color-coded; black designating NC and silver designating NO. Contacts to be rated ten (10) amperes continuous, 7200 VA make,

720 VA break for 120 through 600 Vac, and 69 VA make and break for 125 through 300 Vdc. Provide a minimum of one (1) spare NO contact and one (1) spare NC contact in addition to any auxiliary contacts required.

- b. Provide a mechanical interlock on reversing or multispeed contactors of the lever-type mechanism (with electrical contacts included) to prevent closing of one contactor when the other is closed.
- c. *Provide control modules to perform the indicated input/output control functions as shown on the contract drawings. Modules shall incorporate faceplates having membrane-type pushbuttons and LEDs. All pushbutton and LED functions shall be provided with clearly written identification. Control modules shall be provided with 6-foot connection cord and single plug-in wiring to accommodate jack provided in the contactor. Provide as required, modules available to cover applications ranging from full-voltage non-reversing, reversing, multispeed, and reduced voltage. Modules shall be provided with the ability to replace conventional "start," "stop," "hand," and "auto," control functions and with the ability to replace conventional indicating light status of "run," "off," "overload alarm," and "overload trip."
- d. *Provide a metering module capable of displaying control voltage and status where utilized in starter applications, "cause of trip," "current at time of trip" and "current in each phase" shall be capable of being displayed.
- e. **[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.:
 - 1. On-Off reset control functions
 - 2. Status (On, Off, Tripped, No Response)
 - 3. Current in each phase
 - 4. Percent phase unbalance
 - 5. Control voltage
 - 6. Overload protection settings
 - 7. Cause of trip
 - 8. Trip current magnitude

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- e. **Provide] [Make provisions for] an addressable communication card capable of transmitting control and diagnostic data over an open DeviceNet network to a personal computer or PLC. The addition of the DeviceNet communication module shall not increase the size of the controller. The starter shall also be capable of transmitting the following data:
 - 1. On-Off reset control functions
 - 2. Status (On, Off, Tripped, No Response)
 - 3. Current in each phase
 - 4. Percent phase unbalance

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5. Control voltage
6. Overload protection settings
7. Trip current magnitude
8. Average motor current
9. Hand/Manual/Local control
10. Cause of trip indication
 - i. Phase loss
 - ii. Phase unbalance
 - iii. Ground fault
 - iv. Thermal trip.
11. Microprocessor-based motor starters shall be Cutler-Hammer Advantage Series or approved equal
12. *Provide a reset and trip indicator for remote mounting. Reset and trip indicator pushbutton shall be 30 mm NEMA 4 oiltight-rated and completely assembled, including legend nameplate, into the side of the motor starter. Reset and trip indicator shall have overload alarm indication and trip indication
13. *Provide a bell alarm module with one (1) NO and one (1) NC contact rated five (5) amperes continuous, 120 volts, 2880 VA make and 480 VA break

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B. Motor Starters – Freedom Design

1. Magnetic starters through NEMA Size 9 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring. Each starter shall have one (1) NO auxiliary contact
2. Coils shall be of molded construction through NEMA Size 9. All coils to be color-coded through size 5 and permanently marked with voltage, frequency and part number
3. Overload relays shall be an ambient compensated bimetallic-type with interchangeable heaters, calibrated for 1.0 and 1.15 service factor motors. Electrically isolated NO and NC contacts shall be provided on the relay. Visual trip indication shall be standard. A test trip feature shall be provided for ease of troubleshooting and shall be conveniently operable without removing components or the motor starter. Overload to have (+/-) 24% adjustability, single-phase sensitivity, and isolated alarm contact, and manual or automatic reset

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3. Solid-State Overload Relay

- a. Provide a solid-state overload relay for protection of the motors. The relay shall be Cutler-Hammer type CEP7 or approved equal.
- b. The overload relay shall provide high accuracy through the use of state-of-the-art microelectronic packaging technology. The relay shall be suitable for application with NEMA Size 1 through Size 7 motor starters.

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- c. The overload relay shall be modular in design, be an integral part of a family of relays to provide a choice of levels of protection, be designed to directly replace existing electromechanical overload relays, and be listed under UL Standard 508.
- d. The overload relay shall have the following features:
 - 1. Be self-powered
 - 2. Class 10 or 20 fixed tripping characteristics
 - 3. Manual or automatic reset
 - 4. Phase loss protection. The relay shall trip in 2 seconds or less under phase loss condition when applied to a fully loaded motor
 - 5. Visible trip indication
 - 6. One NO and one NC isolated auxiliary contact
 - 7. Test button that operates the normally closed contact
 - 8. Test trip function that trips both the NO and NC contacts
 - 9. A current adjustment range of 3.2:1 or greater
 - 10. Ambient temperature compensated
 - 11. *Ground fault protection. Relay shall trip at 50% of full load ampere setting
 - 12. *Jam/Stall protection. Relay shall trip at 400% of full load ampere setting, after inrush
- 4. NEMA Size 00 through 2 starters shall be suitable for the addition of at least six (6) external auxiliary contacts of any arrangement normally open or normally closed. Size 3 through 8 starters shall be suitable for the addition of up to eight (8) external auxiliary contacts of any arrangement normally open or normally closed
- 5. Motor starters shall be Cutler-Hammer Freedom Series or approved equal
- 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) oiltight 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.]
 - 1. Provide electromechanical type motor starters with coil control and overload integrated into a single or dual microcontroller
 - 2. The motor starter shall operate over a temperature range of -40 to 149 degrees F (-40 to 65 degrees C) and shall meet or exceed the following Standards and Certifications: UL, CSA, NEMA ICS1, ICS2, ICS5, IEC 60947-4-1, CE, and KEMA where applicable. Devices shall meet Electromagnetic Compatibility (EMC) Requirements per EMC IEC 61000-4

* Note to Spec. Writer - Optional

3. Provide one toroidal current sensor per phase accurate to 2% providing input to analog circuitry and software which yields a time-current curve paralleling actual motor heating. Motor FLA shall be set via a potentiometer for 1.0 or greater Service Factor settings
4. Provide user-selectable overload trip class of 10, 20 and 30 on each Overload Relay. To adjust factory defaults, Trip Class shall be manually changed using the Test button and FLA dial
5. Provide phase loss and phase current unbalance protection. If the phase unbalance of any phase is greater than or less than approximately 50% of the average, the device trips. This feature is user enabled/disabled and manually changed using the Test button and FLA dial
- 6.*Provide Ground Fault indication for all starter units *[size *_____ and larger] [where indicated on the drawings] by the addition of a D64 ground fault relay. Upon detection of a ground fault the relay shall *[trip the circuit breaker] [trip the starter] [provide indication only]
7. Provide each motor starter with a lockable cover that prevents unwanted tampering of FLA dial settings once installed
8. Provide a microcontroller with the following features:
 - a. Monitor the nominal 24 Vdc and adjust the Pulse Width Modulation (PWM) accordingly to minimize utilized power and maximize contact sealed force
 - b. Energizes coil at full voltage and then applies Pulse Width Modulation.
 - c. Monitors user control inputs (i.e., permissive, stop, forward, reverse, local reset, remote reset, test/test to trip. Control inputs shall be rated 24 Vdc (3 – 5 mA) with a plug and unplug lockable control connector.
 - d. Operates an LED indicator which displays a flash sequence for thermal capacities over 70%, test button depression, trip indication, class setting, phase enablement/disablement, and microcontroller reset condition
 - e. Monitors 3-phase current into a common node
 - f. Sweeps the current waveform to avoid synchronizing with the current waveform
 - g. Provides Thermal Memory (in addition, Thermal Pile, Thermal Capacity) which shall be saved to non-volatile memory for safety purposes in the event of a power loss or removal and restore event
 - h. Controls an alarm output which is a solid-state open collector or emitter type output at 24 Vdc 250 mA
 - i. Shall solve a first order differential equation for an actual motor heating model to calculate trip points
 - j. Provides an “alarm only” or “alarm without trip” mode for critical must run applications
9. Control voltages:
 - a. The starter voltage shall be nominal 24 Vdc from 20 to 28 Vdc.

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- b. 24 Vdc control shall be provided by a separate power supply in each replacement unit.
 - c. Control power for field circuits shall be supplied by *[24 Vdc from the starter unit] [120 Vac from a separate source].
10. Motor starters shall have replaceable fixed and movable contacts, Size 1 through 5
11. Motor starters Size 1 through 5 shall have no laminations, shading coils, or magnet noise
12. Accessories:
- a. Motor starters shall accommodate auxiliary contacts per various maximum combinations of single and dual auxiliaries. Maximum number of circuits shall be six (6) for size 1 through 4 and twelve (12) for size 5 through 7 starters. Contacts shall be rated ten (10) amperes continuous, 7200 VA make, 720 VA break for 120 Vac, 3600 VA make, 360 VA break for 240 Vac, 1800 VA make, 180 VA break for 480 Vac, 1440 VA make, 144 VA break for 600 Vac, and 137.5 VA make and break for 125 through 250 Vdc. No seal-in auxiliary contacts are required.
 - b. Provide mechanical interlock on reversing contactors of a pivot-type mechanism to prevent closing of one contactor when the other is closed. Coil controller energizes both forward and reverse contactors providing one control point for wiring.
 - c. Provide control modules to perform the indicated input/output control functions shown on the drawings. Module shall incorporate faceplates having membrane type pushbuttons and LEDs. All pushbutton and LED functions shall be provided with clearly written identification. Modules shall be provided with the ability to replace conventional start, stop, hand, auto control functions, and overload reset function. Modules shall be provided with the ability to replace conventional indicating light status of run, off, selector switch pushbutton position, and overload trip and circuit breaker trip.
13. Microprocessor-based motor starters shall be Cutler-Hammer *IT* series or approved equal
14. All printed circuit boards shall be conformally coated to provide environmental robustness
15. Motor starters shall provide Manual, Remote Reset, or Auto Reset capability
16. Each starter shall be equipped with two (2) 24 Vdc LED type indicating lights (Run and Stop), HOA switch, an NO OL trip contact, an NC auto contact, and two (2) NO contacts, unless otherwise scheduled on the drawings. Each starter shall utilize 24 Vdc control voltage for safety
17. Reduced Voltage Motor Starter Type S801
- a. Controller shall be Cutler-Hammer type S801.
 - b. The solid-state reduced-voltage starter shall be UL and CSA listed. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, paralleling bypass contactor, and electronic overload relay enclosed in a single molded housing.

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- c. The SCR-based power section shall consist of six (6) back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1500 volts PIV.
- d. Units using triacs or SCR/diode combinations shall not be acceptable.
- e. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dV/dT effects.
- f. The logic board shall be mounted for ease of testing, service and replacement. It shall have quick disconnect plug-in connectors for current transformer inputs, line and load voltage inputs and SCR gate firing output circuits.
- g. The logic board shall be identical for all ampere ratings and voltage classes and shall be conformally coated to protect environmental concerns.
- h. The paralleling run bypass contactor shall energize when the motor reaches 90 of full speed and close/open under one (1) times motor current.
- i. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions.
- j. The coil shall have a lifetime warranty.
- k. Starter shall be provided with electronic overload protection as standard and shall be based on inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads via a DIP switch setting on the device keypad.
- l. Overload protection shall be adjusted via the device keypad and shall have a motor full load ampere adjustment from 30 to 100% of the maximum continuous ampere rating of the starter.
- m. Starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIP switch setting on the device keypad.
- n. Starter shall be capable of either an electronic or mechanical reset after a fault.
- o. Units using bimetal overload relays are not acceptable.
- p. Overtemperature protection (on heat sink) shall be standard.
- q. Starters shall provide protection against improper line-side phase rotation as standard. Starter will shut down if a line-side phase rotation other than A-B-C exists. This feature can be disabled via a DIP switch on the device keypad.
- r. Starters shall provide protection against a phase loss or unbalance condition as standard. Starter will shut down if a 50% current differential between any two phases is encountered. This feature can be disabled via a DIP switch on the device keypad.
- s. Start shall provide protection against a motor stall condition as standard. This feature can be disabled via a DIP switch on the device keypad.
- t. Starter shall provide protection against a motor jam condition as standard. This feature can be disabled via a DIP switch on the device keypad.
- u. Starter shall be provided with a Form C normally open (NO), normally closed (NC) contact that shall change state when a fault condition exists. Contacts shall be rated 60 VA (resistive load) and 20 VA (inductive load). In addition, an LED display on the device keypad shall indicate type of fault (Overtemperature, Phase Loss, Jam, Stall, Phase Reversal and Overload).
- v. The following control function adjustments on the device keypad are required:
 - 1. Selectable Torque Ramp Start or Current Limit Start

2. Adjustable Kick Start Time: 0–2 seconds
 3. Adjustable Kick Start Torque: 0–85%
 4. Adjustable Ramp Start Time: 0.5–180 seconds
 5. Adjustable Initial Starting Ramp Torque: 0–85%
 6. Adjustable Smooth Stop Ramp Time: 0–60 seconds.
- w. Reduced voltage motor starters shall be of the same manufacturer as that of the circuit breaker and motor control center for coordination and design issues.
- E. Control Power Supply units
1. Each replacement unit shall have a control power supply unit that will provide 24 Vdc control power. This will be accomplished by using a single control power supply that converts line voltage to 24 Vdc directly, without the use of a control power transformer
 2. Each power supply unit shall be sized to power the motor starter and any other control devices within the replacement unit. The power supply shall be sized to provide 14 cycle ride-through at 0 V on the primary, when fully loaded
- F. Power supplies shall contain an electronic fuseless overcurrent protection that will safely shut down the power supply in the event of a short circuit on the power supply output.

Note to Spec. Writer:

For more detailed specification information for solid-state reduced-voltage starters refer to Section 16481, Motor Starters – Low Voltage.

- G. Adjustable frequency drives shall be provided in MCC(s) where scheduled. Adjustable frequency drives shall be Cutler-Hammer type MVX and/or SVX9000 for variable torque loads unless otherwise indicated on the drawings. Drives 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. Keypads shall retain all programming information and may be used to program multiple drives easily. 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. Remote mounted Clean Power, CPX9000, drives shall use same keypad.

Note to Spec. Writer:

For more detailed specification information for Adjustable Frequency Drives refer to Section 16483, Adjustable Frequency Drives.

2.06 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

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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

2.07 ENCLOSURES

- A. The type of enclosure shall be in accordance with NEMA standards for type 1A with gasketed doors. All enclosing unit doors shall be gasketed.

2.08 FINISH

- A. The control center buckets 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 buckets 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.

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 1 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. Check all removable cells and starter units for easy removal and insertion
 2. Connect all power wiring and control wiring and verify basic operation of each starter from control power source
 3. Torque all bolted connections made in the field and verify all factory bolted connections
 4. 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 is/are new factory bucket(s), and have 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 1 normal workdays at the job site 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.
- 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.

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.