SECTION 26 29 13.11
MOTOR STARTERS – LOW VOLTAGE

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install the low voltage motor starters as specified herein and as shown on the contract drawings.

1.02 RELATED SECTIONS

A. Section 26 28 11 – Circuit Breakers and Fusible Switches

B. Section 26 29 05 – Electrical Control Devices

1.03 REFERENCES

A. The motor starters shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA, ANSI and UL.

1.04 SUBMITTALS – FOR REVIEW/APPROVAL

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

1. Master drawing index
2. Dimensioned outline drawings
3. Conduit entry/exit locations
4. Cable terminal sizes
5. Wiring diagrams
6. Nameplate schedule
7. Ratings including:
   a. Voltage
   b. Horsepower and/or continuous current
8. 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. Wiring diagrams
3. Seismic certification as specified

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 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.

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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

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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton / Cutler-Hammer products
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 MANUAL MOTOR CONTROL

A. Single-Phase Manual Starters
1. Manual single-phase starters 1 hp or smaller shall be Cutler-Hammer type MS starters or approved equal. The starter shall have a quick-make/quick-break toggle mechanism. The overload shall have a field adjustment allowing up to +/- 10% variance in ratings of the nominal heater value
2. Manual single-phase starters above 1 hp shall be Cutler-Hammer type B100 or approved equal. The starter shall have quick-make/quick-break mechanism. The closure of the contacts shall be blocked while the line terminals are exposed. The operating handle or button shall clearly indicate whether the unit is ON, OFF or TRIPPED
3. The enclosure shall be ☛[general purpose NEMA 1] [general purpose NEMA 1B – flush mounted] [watertight NEMA 3, 4, 5] [hazardous locations NEMA 7D: Class I, Group D] [hazardous locations NEMA 9E, F, G: Class II, Groups E, F, G] [as indicated on the contact drawings]

B. Three-Phase Manual Starters

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1. The starter shall have quick-make/quick-break operating mechanism
2. The operating handle or button shall clearly indicate whether the unit is ON, OFF or TRIPPED
3. The closure of the contacts shall be blocked while the line terminals are exposed
4. The enclosure shall be ☛[general purpose NEMA 1] [general purpose NEMA 1B – flush mounted] [watertight NEMA 3, 4, 5] [hazardous locations NEMA 7D: Class I, Group D] [hazardous locations NEMA 9E, F, G: Class II, Groups E, F, G] [as indicated on the contract drawings]
5. Manual three-phase motor starters shall be Cutler-Hammer type B100 or equal

C. Three-Phase Manual Motor Starter and Protector

1. The starter shall have an adjustable Class 10 ambient compensated integral overload relay and a fixed magnetic short-circuit trip mechanism designed to trip at twelve (12) times the maximum current rating of the starter
2. The starter shall be UL listed and CSA certified for group motor installations with 1200 ampere maximum fuse and circuit breaker ratings at 480 Vac
3. The starter shall have provisions for padlocking in the OFF position
4. The starter shall have accessories such as auxiliary contacts, trip alarm, undervoltage release, and shunt trip available for field installation
5. The enclosure shall be general purpose NEMA 1
6. Motor starter and protector shall be Cutler-Hammer type ☛[A302], [A307], [A308], [A309] [or equal]

2.03 ELECTROMECHANICAL MOTOR CONTROL

A. Non-Reversing Starters

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 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.

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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.
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

B. Reversing Starters

1. Reversing starters shall consist of two (2) contactors and a single overload relay assembled together. The contactors shall be mechanically and electrically interlocked to prevent line shorts and the energizing of both contactors simultaneously
2. Magnetic starters through NEMA Size 8 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring
3. Coils shall be permanently marked with voltage, frequency and part number
4. 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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4. Solid-State Overload Relay

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a. Provide a solid-state overload relay for protection of the motors. The relay shall be Cutler-Hammer type CEP7 or approved equal. 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.
b. 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.
c. 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

5. 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. Sizes 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
6. Motor starters shall be Cutler-Hammer Freedom Series or approved equal

C. Two-Speed Starters

1. Magnetic starters through NEMA Size 6 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring
2. Coils shall be 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

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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.
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 combination of normally open or normally closed contacts. Sizes 3 through 6 starters shall be suitable for the addition of up to eight (8) external auxiliary contacts of any combination of normally open or normally closed contacts
5. Two-speed magnetic starters for motors up to 400 hp, 600 volts shall be Cutler-Hammer Freedom Series type AN700 or approved equal

D. Vacuum Starters

1. Vacuum starters shall incorporate “low-chop” interrupters and limit chop currents to less than 0.5 amperes. Contact material to be silver tungsten carbide
2. Interrupters shall have contact wear detection indicators
3. Vacuum starters shall have front removable coil and auxiliaries
4. The contactor coil shall utilize rectified ac current
5. Provide a “push-to-test” button for Sizes 5 and 6
6. Vacuum contactors shall be Cutler-Hammer Class V200 for non-reversing and Class V210 for reversing
7. 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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7. 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.
   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

2.04 MICROPROCESSOR-BASED MOTOR CONTROL

A. Motor Starters – ***IT*** Design

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
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

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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 each motor starter with a lockable cover that prevents unwanted tampering of FLA dial settings once installed
7. 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 are 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.
   k. Provides built-in logic to provide either 2- or 3-wire control, eliminating the need to provide and wire auxiliary contacts to seal-in and interlock the contactor coil
   l. ✂Starter can be easily networked with the appropriate SNAP device communicating to a factory bus.
8. Control Voltages:
   a. The starter voltage shall be nominal 24 Vdc from 20 to 28 Vdc
9. Motor starters shall have replaceable fixed and movable contacts, Size 1 through 5
10. Motor starters shall have no laminations, shading coils, or magnet noise
11. 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 starters. Contacts shall be rated ten (10) amperes continuous, 7200 VA make, 720 VA break for 120 Vac, 3600 VA

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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.

12. Microprocessor-based motor starters shall be Cutler-Hammer ***IT.*** Series or approved equal

13. All printed wiring boards shall be conformally coated to provide environmental robustness

14. Motor starters shall provide ☛[Manual] [Remote Reset] [Auto Reset] capability

15. ☛[Provide] [Make provisions for] a DeviceNet Starter Network Adapter addressable communication card capable of providing communication capability, control, and monitoring. All data, including trip data, shall be transmitted over the DeviceNet network. The adapter shall serve as a single node on the DeviceNet network. The adapter shall be designed for use with the same 24 Vdc power as the starter. A starter power sensing circuit shall indicate to the network that the starter does not have 24 Vdc power, signaling a fault or an emergency stop. The adapter MAC ID and baud rate shall be manually set. Configuration software shall not be required for normal operation. Configuration software shall be available for configuring advanced features. The adapter shall connect to the starter via an interconnection cable and terminal adapter. The following data shall be transmitted over the network:
    a. RMS average current
    b. Percent of operating full load current
    c. Percent thermal memory
    d. Integral contact position detection
    e. Operating status and fault codes
    f. Start/Stop control
    g. Run/Forward-Reverse control
    h. Trip reset
    i. ✂Fault log
    j. ✂Current level warning (adjustable)
    k. ✂Underload warning (adjustable).

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15. ☛[Provide] [Make provisions for] a QCPort Starter Network Adapter addressable communication card capable of providing communication capability, control and monitoring. All data, including trip data, shall be transmitted over the QCPort network. The adapter shall consume a single QCPort ID. The adapter shall be designed for use with the same 24 Vdc power as the starter. A starter power sensing circuit shall indicate to the network that the starter does not have 24 Vdc power, signaling a fault or an emergency stop. The adapter Group ID shall be manually set. Configuration software shall not be required for normal operation. Configuration software shall be available for configuring advanced features. The adapter shall connect to the starter via an interconnection cable and terminal adapter. The following data shall be transmitted over the network:
    a. RMS average current
    b. Percent of operating full load current
    c. Percent thermal memory
    d. Integral contact position detection
    e. Operating status and fault codes
    f. Start/Stop control
    g. Run/Forward-Reverse control
    h. Trip reset
    i. ✂Fault log
    j. ✂Current level warning (adjustable)
    k. ✂Underload warning (adjustable)

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2.04 SOLID-STATE REDUCED-VOLTAGE MOTOR CONTROL

A. Reduced Voltage Motor Starter Type S801

1. Controller shall be Cutler-Hammer type S801
2. 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
3. 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
4. Units using triacs or SCR/diode combinations shall not be acceptable
5. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dV/dT effects
6. 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
7. The logic board shall be identical for all ampere ratings and voltage classes and shall be conformally coated to protect environmental concerns

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8. The paralleling run bypass contactor shall energize when the motor reaches 90 of full speed and close/open under one (1) times motor current
9. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions
10. 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
11. 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
12. Starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIP switch setting on the device keypad
13. Starter shall be capable of either an electronic or mechanical reset after a fault
14. Units using bimetal overload relays are not acceptable
15. Overtemperature protection (on heat sink) shall be standard
16. 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
17. 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
18. Start shall provide protection against a motor stall condition as standard. This feature can be disabled via a DIP switch on the device keypad
19. Starter shall provide protection against a motor jam condition as standard. This feature can be disabled via a DIP switch on the device keypad
20. 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)
21. The following control function adjustments on the device keypad are required:
    a. Selectable Torque Ramp Start or Current Limit Start
    b. Adjustable Kick Start Time: 0–2 seconds
    c. Adjustable Kick Start Torque: 0–85%
    d. Adjustable Ramp Start Time: 0.5–180 seconds
    e. Adjustable Initial Starting Ramp Torque: 0–85%
    f. Adjustable Smooth Stop Ramp Time: 0–60 seconds.
22. Units enclosed in motor control centers shall be of the same manufacturer as that of the circuit breaker and motor control center for coordination and design issues
23. Maximum continuous operation shall be at 115% of continuous ampere rating

Pump Control Option – Provide control algorithm for pump start-up and shut down sequences. Control algorithm shall reduce the potential for water hammer in a centrifugal

pump system. Upon a start command, the speed of the motor is increased, under the control of the *IT.* Soft Starter microprocessor, to achieve a gentle start. After the speed has reached its nominal value, the bypass contactors close and the pump. Upon a stop command, the bypass contactors are opened and the motor speed is decreased in a tapered manner, to gradually slow the flow until the motor is brought to a stop. The start and stop ramp times are user adjustable and are to be set for the application requirements. The pump control option shall be factory installed.

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A. Reduced Voltage Motor Starter Type S811

1. Controller shall be Cutler-Hammer type S811
2. 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
3. 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
4. Units using triacs or SCR/diode combinations shall not be acceptable
5. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dV/dT effects
6. 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
7. The logic board shall be identical for all ampere ratings and voltage classes and shall be conformally coated to protect environmental concerns
8. The paralleling run bypass contactor shall energize when the motor reaches 90 of full speed and close/open under one (1) times motor current
9. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions
10. Digital interface module mounted on the face of the S811 shall be used to program the soft starter. Display shall include six line LED readout. Monitoring parameters shall include line currents, pole currents, pole voltages, number of starts, and DC control voltage. Soft starter shall display motor status and the previous 5 fault conditions
11. 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 digital interface module
12. 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
13. Starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIP switch setting on the device keypad
14. Starter shall be capable of either an electronic or mechanical reset after a fault

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15. Units using bimetal overload relays are not acceptable
16. Overtemperature protection (on heat sink) shall be standard
17. 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 digital interface module
18. 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 digital interface module
19. Start shall provide protection against a motor stall condition as standard. This feature can be disabled via digital interface module.
20. Starter shall provide protection against a motor jam condition as standard. This feature can be disabled via digital interface module
21. 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)
22. The following control function adjustments from digital interface module are required:
    a. Selectable Torque Ramp Start or Current Limit Start
    b. Adjustable Kick Start Time: 0–2 seconds
    c. Adjustable Kick Start Torque: 0–85%
    d. Adjustable Ramp Start Time: 0.5–180 seconds
    e. Adjustable Initial Starting Ramp Torque: 0–85%
    f. Adjustable Smooth Stop Ramp Time: 0–60 seconds.
23. Units enclosed in motor control centers shall be of the same manufacturer as that of the circuit breaker and motor control center for coordination and design issues
24. Maximum continuous operation shall be at 115% of continuous ampere rating

Pump Control Option – Provide control algorithm for pump start-up and shut down sequences. Control algorithm shall reduce the potential for water hammer in a centrifugal pump system. Upon a start command, the speed of the motor is increased, under the control of the *IT.* Soft Starter microprocessor, to achieve a gentle start. After the speed has reached its nominal value, the bypass contactors close and the pump. Upon a stop command, the bypass contactors are opened and the motor speed is decreased in a tapered manner, to gradually slow the flow until the motor is brought to a stop. The start and stop ramp times are user adjustable and are to be set for the application requirements. The pump control option shall be factory installed.

2.05 ELECTROMECHANICAL REDUCED VOLTAGE MOTOR CONTROL

A. Autotransformer Type

1. The starter shall utilize an autotransformer for a reduced voltage start. The autotransformer shall have adjustable voltage taps at 50%, 65% and 80%

2. The starter shall be ☛[an open] [a closed] transition type
3. The autotransformer shall use ☛[electromechanical] [microprocessor-based] type starters

B. Part-Winding Type

1. The starter shall utilize a part winding connection for a reduced voltage start
2. The part-winding starter shall use ☛[electromechanical] [microprocessor-based] type starters

C. Wye-Delta Type

1. The starter shall utilize a wye-delta connection for a reduced voltage start
2. The starter shall be ☛[an open] [a closed] transition type
3. The wye-delta starter shall use ☛[electromechanical] [microprocessor-based] type starters

2.06 ENCLOSURES

A. The enclosure shall be ☛[general purpose NEMA 1] [NEMA 3R] [NEMA 12] [NEMA 4X] [as indicated on the contract drawings].

B. ☛Starters shall have [an adjustable instantaneous motor circuit protector (HMCP) type] [a thermal-magnetic circuit breaker type] [a fusible type] [a non-fused type] disconnect device.

2.07 OPTIONS

A. Each starter shall be equipped with ✂[a fused control power transformer (100 VA minimum)] [HOA selector switch] [start-stop pushbutton] [red “run” pilot light] [green “stop” pilot light] [2 NO/2 NC auxiliary contacts] [options as indicated on the contract drawings].

PART 3 EXECUTION

3.01 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.

B. The manufacturer shall provide three (3) certified copies of factory test reports.

3.02 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer’s representative to assist the Contractor in installation and start-up of the equipment specified under this section. 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 herein.

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✂Note to Spec. Writer – Optional

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

1. Inspection and final adjustments
2. Operational and functional checks of starters and spare parts.

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.

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 a job site location determined by the owner.

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

C. The training program shall consist of the following:

1. Instructions on the proper maintenance and operation of the equipment.

⸌ Note to Spec. Writer – Insert data in blanks