1. GENERAL

1.1 References

.1 IEC 947-4-1, Part 4: Contactors and motor-starters.

1.2 Related Work

.1 Motor Power Factor Connection: Section 16920

.2 Thermistors: Section 16930

.3 Connections to Mechanical Equipment: Section 16950

1.3 Starter Requirements

.1 In general, there are categories of starting equipment for three phase motors.

.1 Integral Mounted Starters: Some items of mechanical equipment such as boilers, have the starter mounted as part of the equipment. For this equipment, supply disconnects and wire to the terminals of the equipment.

.2 Separately Mounted Starters: For motors without integral mounted starters, supply separately mounted starters as indicated on the Drawings and wire the equipment.

.3 Starters in Motor Control Centres: For motors fed from motor control centres, wire from the equipment to the motor control centres.

.2 Provide manual starters for all single phase motors unless otherwise indicated on the motor schedule.

.3 Provide interlocking between starters where required.

.4 All starter accessories such as pilot lights, Hand-Off-Auto, Start-Stop, etc. whether integrally or remote mounted shall be heavy duty oil tight, unless otherwise specified.

1.4 Shop Drawings and Product Data

.1 Submit shop drawings in accordance with Section 16010 - Electrical General Requirements.

.2 Indicate:

.1 Mounting method and dimensions
.2 Starter size and type
.3 Layout of identified internal and front panel components
.4 Enclosure types
.5 Wiring diagram for each type of starter
.6 Interconnection diagrams.

1.5 Operation and Maintenance Data

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 16010 - Electrical General requirements.

.2 Include operation and maintenance data for each type and style of starter.

1.6 Maintenance Materials

.1 Provide maintenance materials in accordance with Division 01 Maintenance Materials, Special Tools and Spare Parts.

.2 Provide listed spare parts for each different size and type of starter:

.1 [3] contacts, stationary.

.2 [3] contacts, movable.

.3 [1] contacts, auxiliary.

.4 [1] control transformer[s].

.5 [1] operating coil.

.6 [2] fuses.

.7 [10]% indicating lamp bulbs used.

2. PRODUCTS

2.1 Materials

.1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 Enclosure

.1 All individually mounted motor starters shall be enclosed in a general purpose sheet steel enclosure unless in wet areas where they shall be watertight EEMAC 4.

2.3 For all motors 22.4 kW and above, the starters shall contain thermistor control relay and accessories.

2.4 Manual Motor Starters

.1 Manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break

.2 Overload heaters, manual reset, trip indicating handle
.3 Rated volts and poles to suit application.

.2 Accessories:

.1 Heavy duty oil-tight labelled as indicated.

.2 Indicating lights: heavy duty oil tight type and colour as indicated.

.3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.5 Full Voltage Non Reversing (FVNR) Magnetic Starters

.1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type
.2 Motor overload protective device in each phase, manually reset from outside enclosure
.3 Wiring and schematic diagram inside starter enclosure in visible location
.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters to include motor circuit interrupterwith operating lever on outside of enclosure to control motor circuit interrupter, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

.1 Selector switches: heavy duty oil tight labelled as indicated.

.2 Indicating lights: heavy duty oil tight type and red pilot light to indicate energized motor circuit and green pilot light to indicate de-energized motor circuit. Pilot lights to be push-to-test transformer type.

.3 In addition to standard, 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.6 Full Voltage Reversing (FVR) Magnetic Starters

.1 Full voltage reversing magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Two - 3 pole magnetic contactors mounted on common base

.2 Mechanical and electrical interlocks to prevent both contactors from operating at same time

.3 Three overload relays with heater elements, [manual] [automatic] reset.

.2 Accessories:

.1 Selector switches: heavy duty oil-tight labelled as indicated

.2 Indicating lights: heavy duty oil-tight type and color as indicated

.3 Auxiliary control devices as indicated.

2.7 Variable Speed Drive Controller

.1 Minimum Requirements:

.1 Factory C.S.A. certified.

.2 Unit to operate in ambient temperatures ranging from 0° C to +40° C.

.3 Unit to operate at full load with a variation of –15% and +10% of rated building voltage.

.4 Unit to operate at full load with a variation of +5% of rated frequency.

.5 Printed circuit board design using the latest "state of the art" components including microprocessor control of protective circuits.

.6 Suitable for use with standard or high efficiency inverter duty motors.

.7 Installed in motor control centre.

.8 Transformers shall not be used on either the input or output of unit.

.9 The unit shall operate at a switching frequency of 20 kHz or less. The unit shall include reactors or LRC filters within the VSD enclosure as necessary to limit the voltage rise times and maximum peak voltages throughout the specified building voltage range and for all operating conditions at the related motor connections as follows:

.1 Maximum peak voltage 1000 volts.

.2 Maximum voltage rate of rise: 500 volts/microsecond

.10 Unit shall be provided with protection against:

.1 Stalls caused by overcurrent.

.2 Stalls caused by regenerative overvoltage

.3 Overcurrent protection.

.4 Regenerative overvoltage protection.

.5 Overload protection (thermal type).

.6 Ground fault protection.

.7 Instantaneous power failure protection.

.8 Alarm against overload.

.9 Overtemperature of heat sink.

.10 Input power under voltage, over voltage and phase loss.

.11 DC bus over voltage.

.11 The unit shall have the following features:

.1 Adjustable acceleration and deceleration. Across the line starting shall not be possible. A ramp up time from 0 RPM to 1800 RPM of 30 seconds shall be the minimum possible ramp up time.

.2 Voltage/frequency ratio and adjustment.

.3 Power failure restart system.

.4 Frequency range 6 – 60 hertz.

.5 Frequency resolution of 0.5 H4z or better.

.6 Frequency accuracy of +/-0.5% at 25° C.

.7 Able to accept a 4-20 milliamp, 0 to 5 vdc or 0 to 10 vdc external control signal for speed control.

.8 Able to accept a remote start / stop control.

.12 Provide EMI filters to reduce EMI to FCC acceptance levels.

.13 The units shall have the following components:

.1 Run and Stop pushbuttons or switch.

.2 Hand-Off-Auto selector switch remote mounted suppile and installed by Division 17.

.3 Manual speed adjusting potentiometer.

.4 Fused disconnect, lockable.

.5 Trip relay with light.

.6 Run relay with light.

.7 Fused control transformer primary and secondary.

.8 Auto reset thermal overload – relay interlocked in run circuit.

.9 AC semi-conductor rated line fuses for units with a diode bridge converter.

.10 Terminal strip to accept N.C. safety contacts such as freeze stats and smoke alarms to safety shut down VSD when in Hand or Auto position.

.11 Form C contacts to indicate run mode.

.12 Form C contacts to indicate fault or alarm mode.

.13 0 to 10 vdc output signal directly proportional to controller's speed.

.14 Integral factory wired and mounted bypass provisions such that the controlled motors can be manually put into operation bypassing the speed drive controller.

.14 Unit shall be equipped with harmonic filters on the power input side as necessary to prevent the backfeeding of harmonics into the power system. Maximum level allowed is 5% of voltage Total Harmonic Distortion (THD).

.15 All power wiring connections shall be by Division 16 and all control wiring by the Division 17.

.16 The manufacture's representative shall be present at start-up and shall supervise the start-up and test the voltage at the motor connection with the Commissioning Agency present with a digital oscilloscope with storage capacity and with a sufficiently fast sample time to accurately measure voltage rate of rise to confirm that the voltage spikes and rate of rise are within the specified level. Submit the results to the Consultant including the input voltage on all three phases to the VSD at the time of measurement.

.17 Provide a parts and labour warranty for three years subsequent to Substantial Completion on the Variable Speed Drives.

.18 Provide a three year parts and labour warranty against VSD related failure for each motor connected to a VSD power output.

.19 Shop drawings shall include:

.1 Dimensional drawings.

.2 All connection points.

.3 Power circuit diagrams.

.4 Installation and maintenance manuals.

.5 Warranty description.

.6 Certification of agency approvals.

.7 Conformance to each specified requirement.

.8 Placement of input and output reactors / filters, EMI filters, semi-conductor rated fuses (where required).

.9 Harmonic analysis indicating the level of harmonic distortion that the drives will cause.

3. EXECUTION

3.1 Installation

.1 Install starters and variable frequency drives as indicated.

.2 Ensure correct fuses and overload devices elements installed.

3.2 Starter Verification

.1 Field check motor starters supplied prior to commissioning equipment. As a minimum, verify the following:

.1 Check of control circuits
.2 Verify that overload relay installed is correctly sized for motor used
.3 Record overload relay size and motor nameplate amperage
.4 Visual inspection of fuses and contactors
.5 Ensure all connections are tight.

.2 Measure and record motor amps, under load conditions and compare with full load amps and motor service factor. Report any excessive readings and unbalance. Measure voltage as close to motor terminals as possible while motor is running

.3 Set all motor circuit protectors to the minimum level which will consistently allow the motor to start under normal starting conditions.

3.3 Overload Relays

.1 For starters provided, select overload relays in accordance with relay and motor manufacturers' recommendations, considering motor service factors, ambient temperature, temperature differences between motor and starter locations. Monitor motor operation during startup to ensure motor operation is satisfactory and relays provide proper protection. For side inlet fans and other long acceleration time loads, provide special overload relays to

suite the start-up condition. Provide manufacturers' curves and data sheets where necessary to provide supporting data for motor protection.

3.4 Field Quality Control

.1 Perform tests in accordance with Section 16980 - Testing, Adjusting and Balancing of Electrical Equipment and Systems and manufacturer's instructions.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

1. GENERAL

1.1 Related Work

.1 Cast-in Place - Concrete - Installation of anchor devices, channel base sills, setting templates: Division 03

.2 Motor Starters to 600 Volt: Section 16811

.3 Motor Power Factor: Section 16920

.4 Thermistors: Section 16930

.5 Connections to Mechanical Equipment: Section 16950

1.2 References

.1 CAN/CSA-Q9000, Quality Management and Quality Assurance Standards - Guidelines for Selection and Use.

1.3 Shop Drawings

.1 Submit shop drawings in accordance with Section 16010 - Electrical General Requirements.

.2 Indicate:

- .1 Outline dimensions
- .2 Configuration of identified compartments
- .3 Floor anchoring method and dimensioned foundation template
- .4 Cable entry and exit locations
- .5 Dimensioned position and size of busbars and details of provision for future extension
- .6 Schematic and wiring diagrams.

1.4 Operation And Maintenance Data

.1 Provide operation and maintenance data for motor control centre for incorporation into manual specified in Section 16010 - Electrical General Requirements.

.2 Include data for each type and style of starter.

1.5 Maintenance Materials

.1 Provide maintenance materials in accordance with Division 01 - Maintenance Materials, Special Tools and Spare Parts.

1.6 Source Quality Control

.1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

.2 Manufacturer to provide proof of quality control program in accordance with CAN/CSA-Q9000.

2. PRODUCTS

2.1 Supply Characteristics

.1 600 V, 60 Hz, delta connected, 3 phase, 3 wire.

2.2 General Description

.1 Compartmentalized vertical sections with common power busbars.

.2 Metal enclosed, free standing, enclosed dead front.

.3 Indoor EEMAC type 1A gasketted enclosure, front mounting.

.4 Class I Type B

.5 Pre Approved: Square D, Siemens, Allen-Bradley, Centreline, Cutler Hammer.

2.3 Vertical Section Construction

.1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.

.2 Each vertical section divided into compartment units, minimum 305 mm high, as indicated.

.3 Each unit to have complete top and bottom steel plate for isolation between units.

.4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.

.5 Vertical wireways c/w doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

.6 Openings, with removable coverplates, in side of vertical sections for horizontal wiring between sections.

.7 Incoming cables to enter at top with terminals as indicated.

.8 Provision for outgoing cables to exit via top or bottom with terminals.

.9 Removable lifting means.

.10 Provision for future extension of one end of motor control centre including busbars without need for further drilling, cutting or preparation in field.

.11 Divide assembly for shipment to site, complete with hardware and instructions for re-assembly. Contractor to confirm shipping splits.

2.4 Sills

.1 Continuous 75 mm x 25 mm channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

2.5 Busbars

.1 Main horizontal and branch vertical, three phase high conductivity tin plated copper busbars in separate compartment bare self-cooled, extending entire width and height of motor control centre, supported on insulators and rated:

.1 Main horizontal busbars: 600 A
.2 Branch vertical busbars: 300 A.

.2 Branch vertical busbars for distribution of power to units in vertical sections.

.3 No other cables, wires, equipment in main and branch busbar compartments.

.4 Brace buswork to withstand effects of short-circuit current of 42kA rms symmetrical.

.5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

2.6 Ground Bus

.1 Copper ground bus extending entire width of motor control centre.

2.7 Motor Starters And Devices

.1 Equip the MCC with the combination starters as specified in Section 16811 - Motor Starters to 600 V, and as shown on the drawings.

2.8 Starter Unit Compartments

.1 Units EEMAC size 5 and smaller, circuit breaker units 225 A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.

.2 Unit mounting:

.1 Engaged position - unit stabbed into vertical bus.

.2 Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.

.3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.

.4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.

.3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for one and four padlocks to lock operating handle in "off" position and lock door closed.

.4 Hinge unit doors on same side.

.5 Overload relays manually reset from front with door closed.

.6 Pushbuttons, selector switches and indicating lights mounted on door front.

.7 Devices and components by one manufacturer to facilitate maintenance.

.8 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

2.9 Wiring Identification

.1 Provide wiring identification in accordance with Section 16010 - Electrical General Requirements.

2.10 Equipment Identification

.1 Provide equipment identification in accordance with Section 16010 - Electrical General Requirements.

.1 Motor control centre main nameplate: size No. 7, engraved as indicated .

.2 Individual compartment nameplates: size No. 5, engraved as indicated.

2.11 Finishes

.1 Apply finishes in accordance with Section 16010 - Electrical General Requirements.

.2 Paint motor control centre exterior light gray and interiors white.

3. EXECUTION

3.1 Installation

.1 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.

.2 Make field power and control connections as indicated.

.3 Ensure correct overload heater elements are installed.

.4 Some re-arrangement of compartments is permitted from that indicated to suite manufacturer's standards, provided that re-arrangement give approximately the spaces shown on the drawings. Submit arrangement drawings to the Consultant before starting detailed drawings.

.5 Coordinate concrete pad with bevelled edges as shown on the drawings, sized to suit MCC, install and level channel sills and mount MCC.

.6 Provide control centres with vertical sections, each 2286 mm high, 508 m deep and 508 mm wide, assembled into a group having a common power bus and forming an enclosure to which additional sections may be readily added. Provide drip shields on all motor control centre sections.

.7 Provide main circuit carrying parts cable of withstanding, without damage, a line to line or line to ground shot circuit corresponding to a symmetrical RMS current of 42 KA amperes, unless otherwise indicated. Brace main busses to withstand a similar short circuit.

.8 Design for all power and control connections to be made from the front. All bus and feeder bolted connections shall be accessible from the front.

.9 Sections with horizontal wiring spaces top and bottom and with 102 mm full height vertical wiring spaces with cable tile supports. Insulate wireways from horizontal and vertical bus.

.10 Incorporate starters, circuit breakers, panels, etc. as detailed. Provide shop drawings for review before commencing fabrication.

.11 Provide all spaces complete with bussing hardware and other accessories required so that additional combination starter units can be readily installed. Provide barriers to isolate the space from all bus work.

.12 For each section of structure, provide a 3 phase horizontal bus rated as shown, and a 3 phase vertical bus rated 300 amperes. Tin plate vertical and horizontal bus at each joint. Provide a continuous copper ground bus in bottom of each section. where indicated on MCC schedule, provide fully rated neutral. Bus shall be copper with labyrinth design insulation - isolation for vertical bus.

.13 Contain each complete control device within an individual metal enclosure complete isolated from all other equipment. Provide plug-in type units.

.14 Provide tin plated copper bus bar stabs reinforced with strong spring steel to ensure high contact pressure..

.15 Equip door of each individual unit with a removable plate replaceable with similar [plate complete with pushbuttons, pilot lights or selector switches as required. Use pilot lights of push-to-test type and push button of heavy duty oil tight construction.

.16 Provide appropriate flanges and bus connections for incoming line and feeders.

.17 All joints and connections to be tin plated, cadmium plate all bolts, nuts and lock washers to resist corrosion.

.18 Provide pull apart terminal block plug in each starter for all external control connections, such that each starter unit may be easily removed. All terminals shall be identified.

.19 provide barriers to isolate all buswork to prevent accidental contact when starter units are removed or spaced are provided. Barriers shall also provide phase to phase isolation of the vertical bus.

.20 Complete control wiring diagrams for each starter with conductor identification clearly shown shall be affixed to the interior cover of the starter section or provide a book of wiring diagrams for all starters in each MCC.

.21 Provide complete spare starters, one each of size 1, 2, and 3.

.22 MCCs shall be fitted with on main 600V / 120V control transformer of sufficient V.A. capacity to handle the control requirements of the whole unit plus capacity for external control devices.

.23 Primary H.R.C. fusing shall be installed on the control transformer.

.24 On the secondary side of the control transformer install 15 amp branch circuit breakers, each branch circuit feeding one vertical stack of the MCC. In each starter module install a control circuit fuse rated to give overload protection to the control circuit. These fuses shall be English Electric "Red Spot" fuse fitting Cat. #CRS154 or approved equal.

.25 Each MCC containing three or more vertical sections shall contain a control terminal section consisting of one full stack in height and depth. It shall be barriered from the adjacent 600 volt section. The control terminal section shall be complete with a solid back pan at the rear for the installation of control terminals.

.26 Control wiring shall be extended from each starter module to the control terminal section. including all auxiliary contacts. A multi unit style terminal block having screw type terminal connections shall be installed on standoff supports on back plate.

.27 All terminals shall be number coded or otherwise suitably identified to indicate which section or module of the MCC they are associated with and their function.

3.2 Starter Verification

.1 Field check motor starters supplied prior to commissioning equipment. As a minimum, verify the following:

- .1 Check of control circuits
- .2 Verify that overload relay installed in correctly sized for motor used
- .3 Record overload relay size and motor nameplate amperage
- .4 Visual inspection of fuses and contactors
- .5 Ensure all connections are tight.

.2 Measure and record motor amps, under load conditions and compare with full load amps and motor service factor. Report any excessive readings and unbalance. Measure voltage as close to motor terminals as possible while motor is running.

.3 Set all motor circuit protectors to the minimum level which will consistently allow the motor to start under normal starting conditions.

3.3 Overload Relays

.1 For starters provided, select overload relays in accordance with relay and motor manufacturers' recommendations, considering motor service factors, ambient temperature, temperature differences between motor and starter locations. Monitor motor operation during start-up to ensure motor operation is satisfactory and relays provide proper protection. For side inlet fans and other long acceleration time motors, provide special overload relays to suit the start-up condition. Provide manufacturers' curves and data sheets where necessary to provide supporting data for motor protection.

3.4 Field Quality Control

.1 Perform tests in accordance with Section 16980 - Testing, Adjusting and Balancing of Electrical Equipment and Systems.

.2 Ensure moving and working parts are lubricated where required.

.3 Operate starters in sequence to prove satisfactory performance of motor control centre during 8 h period.

END OF SECTION

MOTOR POWER FACTOR CORRECTION

1. GENERAL

1.1 Related Work

.1 Electrical General Requirements: Section 16010

.2 Motor Starters to 600 V: Section 16811

.3 Motor Control Centre: Section 16820

1.2 Starter Requirements

.1 Provide power factor correction for 3 phase squirrel cage induction motors longer than 15 HP by means of capacitors installed at the motor location, connected between the starter load terminals and the motor terminal box, or at the starter where so indicated.

1.3 Regulatory Requirements

.1 The design, construction and assembly of the power factor correction assembly shall conform to CSA 22.1 and CSA No. 190.

2. PRODUCTS

2.1 Capacitors

.1 Constructed of metallized polypropylene impregnated with non PCB oil.

.2 One piece extruded aluminum housing.

.3 Built-in overpressure fuse - self healing type.

.4 Temperature range of -40 degrees C to +50 degrees C.

.5 Losses shall be less that .5 watts per KVAR.

.6 Provide discharge resistor to decrease terminal voltage to 50 volts one minute after disconnection.

2.2 Enclosure

.1 CEMA 1 enclosure finished in acrylic enamel to match motor control centre.

.2 Modular mounting of capacitors on rack assembly.

.3 Wall mounted.

3. EXECUTION

3.1 Installation

.1 Size capacitors in accordance with the manufacturer's recommendations. The following is a guide to the requirements, based on 1,800 RPM motors.

MOTOR HP	kW	CAPACITOR kVAR
15	112	5
20	15	6
25	18.6	7.5
30	22.4	8
40	29.8	13
50	37.3	18
60	44.8	21
75	56	23
100	74.6	30
125	93.3	36
150	111.9	42
200	149.2	50
250	186.6	60
300	223.8	68
350	261.1	75
400	298.4	80
450	335.7	90
500	373	120

.2 Final selection of capacity size shall not be made until motor vendor is determined, and final kilowatts and speeds approved. Size the capacitors for the particular application and submit a list of the capacitors so sized, for review. Increase or decrease the kVARs for each capacitor, above or below the guidelines listed above, in accordance with vendor's requirements, at no additional cost to the Owner.

.3 Adjust overload relay sizes to correspond to reduced line currents.

.4 Install capacitor unit adjacent to motor control centre.

.1 Connect capacitor at the motor starter on load side of contactor, but on the line side of motor overloads.

.1 For capacitors 10 KVAR and larger supplying compressor loads connect capacitors by a contactor on the load side of the motor starter. Contactor shall be controlled by motor starter.

END OF SECTION

THERMISTORS

1. GENERAL

1.1 Requirements

.1 Thermal protection for motors is to be provided to shut off the motors should the motor temperature exceed prescribed limits. This protection is to prevent insulation damage due to multiple starts and long term overload. Thermistors are not to replace motor overload relays, but are to be used in conjunction with these relays.

2. PRODUCTS

2.1 Thermistors

.1 For 600 volt, 3 phase motors, 22.4 kW and above or as indicated on the drawings (except chillers) motors will be supplied with thermistors embedded in the motor windings. For each motor so equipped, provide a Siemens 3 UN6 control relay or equal, with manual reset button and pilot "Tripped" light.

3. EXECUTION

3.1 Installation

.1 Connect motor thermistors to control relay. In general, install these control conductors in a separate conduit or use shielded cables.

.2 Wire control relay into starter circuit so as to shut motor off if the thermistor operates.

.3 For motors having starters located in MCCs, install control relay in motor starter.

.4 For motors having separate starters, provide an enclosure for relay, and install adjacent to starter.

.5 For motors provided with starters as part of equipment, thermistors and wiring are not part of the work of this Division.

END OF SECTION

1. GENERAL

1.1 Related Work

.1 Mechanical: Division 15

.2 Motor Starters: Section 16811

1.2 Requirements

.1 Provide a complete system of wiring to motors and controls as specified herein and as shown on the drawings.

.2 Unless specifically noted otherwise, wire and leave in operation all electrically operated equipment supplied under all contracts related to this project. Examine the drawings and shop drawings of all Divisions for the extent of electrically operated equipment supplied under other contracts.

.3 All control wiring diagrams shown on the drawings illustrate typical control circuits applicable to the equipment. Control circuits may vary with different manufacturers of equipment. Verify all control circuits with the suppliers of the equipment and make any corrections that may be required.

.4 Unless specifically noted otherwise, supply all pushbuttons, relays, starters, etc., necessary for the operation of equipment. Check all starters, relay coils and thermal elements to ensure that they provide the necessary protection for motors.

.5 Do not operate motors and controls until approval is obtained from the trade providing equipment.

.6 Examine drawings and shop drawings of other Divisions to obtain exact location of motors and equipment shown on drawings. Where necessary, obtain conduit locations from other trades' drawings and shop drawings.

.7 Assist in placing in operation all mechanical equipment having electrical connections.

.8 Provide three phase starters with fused 120 volt control transformers and overload relays.

.9 Provide all power wiring for all motors and control wiring as indicated on the drawings.

.10 In general, wiring for freezestats, firestats, E.P. switches, P.E. switches, dampers, temperature controllers, flow switches, solenoid valves, etc., for heating ventilating and air conditioning equipment will be under a separate contract. Provide terminations in starters and MCCs for control wiring so that starter control circuits may be extended. Where 120 volt power is required for mechanical equipment, i.e., roll type filters, refrigerated aftercoolers, control cabinets, etc. wiring to the equipment terminals is the work of this Division.

.11 Refer to Motor Control Equipment Schedule.

.12 Some specific definitions of equipment wiring responsibilities are as follows:

.1 Condenser Water Pumps, Chilled Water Pumps

.1 Provide all 120V and 208V wiring for this equipment. Provide all 120V control wiring to chiller control panel to provide pump operation and interlocking as shown on the drawings.

.2 Fans

.1 Provide all 120V and 208V power wiring. Except where specifically noted otherwise, all control for fans is to be supplied, installed and wired from the starter control circuits to the equipment under Division 15. Fire alarm and smoke detection systems shall be wired to shut down fans by this Division.

.3 Pumps for Sprinkler System, Domestic Water, Plumbing & Drainage Systems

.1 Provide all 120V and 208V power wiring. Except where specifically noted otherwise, all control for fans is to be supplied, installed and wired from the starter control circuits to the equipment under Division 15. Fire alarm and smoke detection systems shall be wired to shut down fans by this Division.

.4 Pumps for Sprinkler System, Domestic Water, Plumbing & Drainage Systems

.1 Provide all 208V and 120V wiring as shown on the drawings.

.5 Unit Heaters

.1 Provide power wiring and starters for unit heater fans. Install and wire line voltage thermostats supplied by others. Where thermostats are low voltage or pneumatic, control wiring is under Division 15.

.6 Forced Flow Convectors

.1 Provide 120V power supply to the convectors. Starters, speed controllers and temperature controllers will be supplied and wired under Division 15.

2. PRODUCTS

2.1 3 Phase Motor Disconnect Switches

.1 Industrial Type "A", having quick make, quick break visible blade mechanism, cover interlocks and padlocking switch in the closed or open position. Use EEMAC 4 enclosures outdoors, and EEMAC 1 indoors switches to be H.P. rated, Westinghouse heavy duty type.

2.2 120 Volt, 1 Phase Disconnect Switches

.1 Manual starter without overload relay.

2.3 208 Volt, 1 Phase Motor Disconnect Switches

.1 Manual starter without overload relay.

3. EXECUTION

3.1 Installation

.1 Provide disconnect switches adjacent to all motors.

.2 Provide all wiring between all force flow and unit heaters and their thermostats. Install wiring between all flow switches and valve monitors and the fire alarm panel.

.3 Do control wiring as indicated on the drawings and the motor control schedules.

END OF SECTION

STARTING OF ELECTRICAL EQUIPMENT AND SYSTEM

1. GENERAL

1.1 Related Work

.1 Testing, Adjusting and Balancing of Electrical Equipment and Systems: Section 16980

.2 Electrical Equipment and Systems Demonstration and Instruction: Section 16990

1.2 Coordination

.1 Coordinates starting of electrical equipment and systems with testing, adjusting and balancing, and demonstration and instruction of:

.1 Electrical equipment and systems specified in Division 16

.2 Mechanical equipment and systems specified in Division 15

.3 Other equipment and systems specified in other Divisions.

.2 Where any equipment or system requires testing, adjusting or balancing prior to starting, ensure that such work has been completed prior to starting of electrical equipment and systems.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Energizing Main Electrical System

.1 Prior to energizing main electrical system:

.1 Verify supply authority voltage and phase rotation.

.2 Close and open all devices to ensure proper mechanical operation.

3.2 Starting Motors

.1 Prior to starting motors:

.1 Verify phase rotation at motor control centres.

.2 Confirm motor nameplate data with motor starter heater overloads.

3.3 Energizing Equipment

.1 Prior to energizing equipment provided under other Sections and equipment provided by Minister the Owner.

.2 Confirm equipment nameplate data with characteristics of power supply.

END OF SECTION