ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes ac, enclosed controllers rated 600 V and less, of the following types:
   1. Across-the-line, manual and magnetic controllers.
   2. Reduced-voltage controllers.
   3. Multispeed controllers.

B. Related Sections include the following:
   1. Division 26 Section "Electrical Power Monitoring and Control" for interfacing communication and metering requirements.
2. Division 20 Section "Variable Frequency Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on constant torque loads in ranges up to 200 hp.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each enclosed controller.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
   a. Each installed unit's type and details.
   b. Nameplate legends.
   c. Short-circuit current rating of integrated unit.
   d. UL listing for series rating of overcurrent protective devices in combination controllers.
   e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Qualification Data: For testing agency.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:

1. Routine maintenance requirements for enclosed controllers and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 REFERENCES

A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

B. ANSI/UL 198C - High-Intensity Capacity Fuses; Current-Limiting Types.

C. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.

D. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).
E. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.


G. NEMA AB 1 - Molded Case Circuit Breakers.

H. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

I. NEMA KS 1 - Enclosed Switches.


1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prior to beginning work on any system, verify all existing conditions that affect the work and coordinate with all other trade Contractors. Determine that the work can be installed as indicated or immediately report to the Architect/Engineer errors, inconsistencies or ambiguities.

B. Deliver products to site under provisions of Section 26 0100. Store and protect products under provisions of Section 26 0100.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with manufacturer's written instructions. Lift large equipment only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

E. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable
materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.7 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of each contactor and indicate circuits controlled. Submit under provisions of 26 0100.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electrical service.

2. Indicate method of providing temporary utilities.

3. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.9 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

D. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

E. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.

2. Indicating Lights: Two of each type installed.

3. Keys: Furnish 2 of each to Owner.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Danfoss Inc.; Danfoss Electronic Drives Div.
3. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
4. Square D.

2.2 ACROSS-THE-LINE ENCLOSED CONTROLLERS

A. Manual Controller: NEMA ICS 2, general purpose, Class A, with "quick-make, quick-break" toggle or pushbutton action, and marked to show whether unit is "OFF," "ON," or "TRIPPED."

1. Overload Relay: Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 10 tripping characteristics. Relays shall have heaters and sensors in each phase, matched to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.

B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.

1. Control Circuit: 120 V; obtained from integral control power transformer with sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
2. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

C. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.

1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.
2.3 VARIABLE FREQUENCY CONTROLLERS
   A. Refer to Division 20 “Variable Frequency Controllers.”

2.4 ENCLOSURES
   A. Description: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless
      otherwise indicated to comply with environmental conditions at installed location.
      1. Outdoor Locations: NEMA 250, Type 3R.
      2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.5 ACCESSORIES
   A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
   B. Push-Button Stations, Pilot Lights: NEMA ICS 2, heavy-duty type.
   C. Indicating Lights: Run (Red), off or ready (Green).
   D. Auxiliary Contacts: Provide two normally open (N.O.) and two normally closed (N.C.) contacts.
   E. Selector Switch: NEMA ISC 2, mounted in front cover to read “hand/off/auto,” provide auxiliary
      contact for auto position monitoring.
   F. Control Relays: Auxiliary and adjustable time-delay relays.

2.6 FACTORY FINISHES
   A. Finish: Manufacturer’s standard paint applied to factory-assembled and -tested enclosed
      controllers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements,
      installation tolerances, and other conditions affecting performance.
      1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS
   A. Select features of each enclosed controller to coordinate with ratings and characteristics of
      supply circuit and motor; required control sequence; duty cycle of motor, controller, and load;
      and configuration of pilot device and control circuit affecting controller functions.
   B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION
   A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel
      channels bolted to wall. For controllers not at walls, provide freestanding racks complying with
      Division 26 Section "Hangers and Supports for Electrical Systems."
   B. Install freestanding equipment on concrete bases.
C. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

E. Install motor control equipment and contactors in accordance with manufacturer's instructions.

F. Select and install heater elements in motor starters to match installed motor characteristics.

G. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.4 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 3.

3.5 IDENTIFICATION

A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Electrical Identification."

3.6 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers according to Division 26 Section "Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
   1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
   2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.7 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

3.8 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.

2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.


C. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"

1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS, "Motor Control - Motor Starters." Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.9 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 1 Section "Closeout Procedures."

MOTORS AND MOTOR CONTROLS
MARCH 17, 2008

1. Related Work: Air conditioning chiller starters and fire pump controllers shall be specified with the equipment in Divisions 21 and 23. Wiring from switchgear or switchboard to this equipment shall be specified in Division 26.

2. NEMA and NEC Requirements:
   a. Motors and motor control equipment shall conform to NEMA voltage ratings. A motor rated for 230 volts may not be used on a 208V system. Associate shall specify a 208V motor or buck/boost type transformer to achieve the required 230V.
   b. Motor branch circuit protective devices shall meet the requirements of NEC 430.

3. Motor Control Centers: Class I, Type B with terminal strip terminations.
   a. Locations: Centers shall not be located where ambient temperature could cause derating of overload devices.
   b. Overload heater charts shall be furnished, mounted inside doors of cabinets or separately framed and mounted outside the equipment.

4. Reduced Voltage Starters: Motors, sizes shall be such that if the inrush current exceeds 40 percent of the building transformer rating. Motors shall be equipped with reduced voltage starters of the closed transition auto transformer or star-delta type, or solid state soft start, or current ramp starters.

5. Operating Protection:
a. Certification by the motor manufacturer that motors meet the voltage requirements of NEMA.

b. Overload Relays: Polyphase motor controls shall be equipped with three (3) overload relays. Reduced voltage starters shall provide overload protection during the starting step.

c. Provide 20% spare starters of each size used and provide 25% spare positions for additional starters. Provide space on floor for one (1) additional section.

MOTOR STARTER APPLICATIONS
MARCH 17, 2008

1. Type of Starters: Alternating current (AC) magnetic fused type starters, NEMA Class E2 in accordance with ANSI/NEMA ICS2-1983 (26) shall set current limiting power fuses and magnetic air break contactors. Each starter shall be completely self-contained, pre-wired, and with all components in place. Air break contactors, if employed, shall be current rated based on motor horsepower requirements. It is important to know as a guideline that combination starters will provide an interrupting fault capacity of 260 MVA symmetrical on a 2300V system and 520 MVA symmetrical on a 4160 or 4800V system. This starter must comply with ANSI/NEMA ICS2-1983 (26), Class E-2 controllers NEC 2005-760 and applicable IEEE and current ANSI standards.

   a. Starters for 600V and Below: The design must conform to ANSI/NEMA ICS2-1983 (26). This is a requirement for magnetic controller ratings of 115-575V. AC motor starters and contactors may be used for controlling the circuit to the motor. This standard requires that starters should be carefully applied on circuits and in combination with joint short circuit protective devices such as circuit breakers, fusible disconnects that will limit the available fault current and let through energy level that starter can safely withstand. This withstand must meet the requirements of ANSI/UL 508/1983 (29) and ANSI/NEMA ICS1-1983 (25), (26) which cover controls, systems and devices. Control circuits shall be 120V or less.

   b. The starters shall not be used without an adjacent line switch, if unfused disconnect switch is used or installed, it must be close to each motor as much as possible. This standard forbids the installation of a remote switch with lock arrangement, switchgear, switchboard or a unit in a control center.

**END OF SECTION**