SECTION 230511 – HVAC ELECTRICAL PROVISIONS

PART 1 - GENERAL

1.1. SUMMARY

A. This section includes electrical equipment, materials and work that are the responsibility of Division 23.

1.2. SUBMITTALS

A. Product Submittals:

1. Product Data: For each type of device, include dimensions, mounting arrangements, location for conduit entries, shipping and operating weights, and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

2. Electrical Connections: Submitted equipment nameplates shall be coordinated with the indicated design electrical characteristics. If the submitted equipment requires changes to the electrical connection(s) (including conduit, wire, circuit breaker, fuse, starter, and disconnect sizes, connection locations, etc.) comply with the requirements of Section 230100. Any changes required to accommodate the equipment shall be responsibility of the contractor.

a. Proposed changes to the design shall be submitted to the Engineer for review and approval.

b. Accepted changes shall be noted by the contractor on the as-built documentation.

B. Close-Out Submittals:

1. Operation and Maintenance Data: For disconnects, motor starters and combination motor starters and disconnects, to include in emergency, operation and maintenance manuals.

1.3. QUALITY ASSURANCE

A. Source Limitations: Obtain motor starters, disconnect switches and combination motor starters and disconnect switches of a single type through one source from a single manufacturer.

1. Exceptions: Disconnect switches that are factory-mounted to HVAC equipment may be provided by the equipment manufacturer.

B. Electrical Components, Devices and Accessories: UL listed and labeled as defined by NFPA 70, the National Electric Code, or equivalent by a qualified testing agency marked for the intended location and application and accepted by the Authority Having Jurisdiction and Engineer.

1. Where requirements of Division 23, Division 26 or NFPA 70 conflict, conform to the strictest requirements.

C. Mechanical Equipment and Materials: UL listed and labeled as defined by State Building Codes or equivalent by a qualified testing agency marked for the intended location and application and accepted by the Authority Having Jurisdiction and Engineer.

D. Testing and listing laboratories of mechanical and electrical equipment shall be accredited by the North Carolina Building Code Council (NCBCC).

1.4. EXTRA MATERIALS

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

1. Fuses: One set for each fused device.

PART 2 - PRODUCTS

2.1. EQUIPMENT ENCLOSURES

A. Provide NEMA-rated equipment enclosures for all disconnect switches, motor starters, control panels, variable speed controllers and other similar electrical equipment. When not otherwise indicated, provide enclosures based on the environments of the installations.

1. Inside, Clean Spaces without Water Piping: NEMA 1.

2. Inside, Utility Spaces and Spaces with Water Piping: NEMA 12.

3. Outside, Normal Ambient Conditions: NEMA 3R.

4. Inside or Outside, Water Features and Equipment (Pools, Fountains, Aquariums, etc.) Spaces: NEMA 4X

5. Inside or Outside, Manholes, Tunnels and Sumps: NEMA 6

6. Inside or Outside, NEC Hazard Class 1 Locations: NEMA 8

7. Inside or Outside, NEC Hazard Class 2 Locations: NEMA 9

2.2. DISCONNECT SWITCHES

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

1. Eaton

2. ABB/General Electric

3. Schneider Electric/Square D

4. Siemens

B. Fusible Disconnect Switches: Single-throw, heavy-duty, service-rated fusible switch, rated for 200 to 600Vac and labeled and listed UL 98 and NEMA KS 1, Type HD with silver-tungsten type fuse clips and equipment ground and neutral kit. When a neutral is not necessary, bond the neutral bus to the enclosure for use as grounding bus. Internal current-carrying components shall be solid copper. Provide auxiliary contacts when needed for control system interface.

C. Non-Fusible Disconnect Switches: Single-throw, heavy-duty, service-rated switch, rated for 200 to 600Vac and labeled and listed UL 98 and NEMA KS 1, Type HD with equipment ground and neutral kit. When a neutral is not necessary, bond the neutral bus to the enclosure for use as grounding bus. Internal current-carrying components shall be solid copper. Provide auxiliary contacts when needed for control system interface.

D. Provide switch accessories required to meet the system requirements indicated.

2.3. MOTOR STARTERS

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

1. Eaton
2. ABB/General Electric
3. Schneider Electric/Square D
4. Siemens

B. Description: Full-voltage, electrically-held, non-reversing, magnetic motor controllers with 24Vac control circuit, hand-off-auto (HOA) switch, push-to-start switch, manual reset switch, auxiliary control and monitoring contacts and accessories required to meet the system requirements indicated. Cover door shall have red and green pilot lights. The green light shall illuminate when "on", and red shall illuminated when "off".

2.4. COMBINATION MOTOR STARTERS AND DISCONNECT SWITCHES

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

1. Eaton
2. ABB/General Electric
3. Schneider Electric/Square D
4. Siemens

B. Description: Combination magnetic motor starter and circuit breaker disconnecting means with auxiliary contacts.

1. Disconnecting Means: Thermal magnetic type molded-case circuit breaker (MCCB) with adjustable instantaneous-trip for each pole, auxiliary control and monitoring contacts and test trip button.
2. Motor Starter: Full-voltage, electrically-held, non-reversing, magnetic motor controllers with 24Vac control circuit, hand-off-auto (HOA) switch, push-to-start switch, manual reset switch, auxiliary control and monitoring contacts and accessories required to meet the system requirements indicated. Cover door shall have red and green pilot lights. The green light shall illuminated when "on", and red shall illuminated when "off".

2.5. MANUAL MOTOR SWITCHES

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

1. Eaton
2. ABB/General Electric
3. Schneider Electric/Square D
4. Siemens

B. Description: Manual motor starter and disconnect switch with thermal overload protection for fractional horsepower motors. Toggle switch shall provide manual "on/off" control of one or two-pole single-phase motors rated up to 1 horsepower. The enclosure shall have green pilot light. The green light shall illuminate when "on". The switch shall have a hand guard to prevent accidental operation and provisions for a padlock in the "off" position. The switch shall be rated for single or two-speed applications as indicated. The enclosure shall be for flush wall-mounting where possible and surface wall-mounting where not.

2.6. FUSES

A. Description: Non-renewable cartridge fuses of the type and size required by NFPA 70 and Division 26.

2.7. SHORT-CIRCUIT CURRENT RATINGS

A. Overcurrent protection devices shall be rated for the ampere interruption current rating indicated in the Division 26 documents. Where the rating is not indicated, provide devices rated for 65,000 AIC.

2.8. POWER AND CONTROL CABLING AND RACEWAY

A. Low-Voltage (100 to 600 V) Power Feeders: Size conductors and raceway per NFPA 70 and Division 26 based on equipment nameplate requirements and manufacturer's installation recommendations.

B. Control-Voltage (Up to 24 V) Cabling: Provide control cabling for HVAC system per NFPA 70 and Division 26 based on the system manufacturer's installation recommendations.

1. Paired Cabling: No. 16 AWG Type CMP plenum-rated twisted pair.

2. Class 1 and 2 Control Circuits: Stranded copper Type THHN-THWN.

3. Class 3 Control Circuits: Stranded copper Type TW or TF.

C. Power Conductors: Copper, solid for No. 10 AWG and smaller and stranded for No. 8 AWG and larger, with THHN-THWN insulation. Aluminum conductors will not be accepted.

D. Grounding Conductors: Copper, solid for No. 8 AWG and smaller and stranded for No. 6 AWG and larger, with THHN-THWN insulation. Aluminum conductors will not be accepted.

E. Conduit:

1. EMT (electrical metallic tubing): Indoor, above-grade applications not subject to damage.

2. RGS (rigid galvanized steel): Indoor, above-grade applications subject to damage and outdoor, above-grade applications.

3. RNC (rigid non-metallic conduit), Type Schedule 40 PVC: Indoor and outdoor, below-grade applications.

4. FMC (flexible metallic conduit): Indoor, above-ceiling applications.

5. LFMC (liquid-tight flexible metal conduit): Outdoor, above-grade applications.

PART 3 - EXECUTION

3.1. INSTALLATION

A. Disconnect Switches: Provide disconnect switches for all HVAC equipment. Disconnect switches shall be sized to comply with NFPA 70. Single fan, blower and pump motors shall be based on nameplate horsepower. All other applications shall be based on nameplate total kW rating. Disconnects shall be provided with dual-element fuses sized based on equipment nameplate rating.

1. Service Disconnect Switches: Where the disconnecting means is not within the line-of-sight, as defined by NFPA 70 and the authority having jurisdiction (AHJ), an additional service disconnect shall be located adjacent to the equipment it feeds.

DISCONNECT SWITCH SIZES for MOTORS

AMPERAGE RATING	MAX HP at VOLTAGE/PHASE					
	115V/1ph	200V/1ph	230V/1ph	200V/3ph	230V/3ph	460V/3ph
30A	1.5	3	3	5	7.5	15
60A	3	7.5	10	15	15	30
100A	-	-	-	25	25	60
200A	-	-	-	50	60	100
400A	-	-	-	100	125	250

DISCONNECT SWITCH SIZES for EQUIPMENT							
AMPERAGE RATING	MAX KW at VOLTAGE/PHASE						
	120V/1ph	208V/1ph	240V/1ph	277V/1ph	208V/3ph	240V/3ph	480V/3ph
30A	2.8	5.0	5.8	6.6	8.6	10.0	19.9
60A	5.8	10.0	11.5	13.3	17.3	19.9	39.9
100A	9.6	16.6	19.2	22.2	28.8	33.2	66.4
200A	19.2	33.3	38.4	44.3	57.6	66.4	132.9
400A	38.4	66.6	76.8	88.6	115.1	132.9	265.7
600A	57.6	99.8	115.2	133.0	172.7	199.3	398.6

B. Motor Starters: Provide all motor starters where required for HVAC equipment to operate as intended. Motor starters shall be sized to comply with NFPA 70 and NEMA rated for magnetic starters.

NEMA STARTER SIZES					
NEMA SIZE	MAX HP at MOTOR VOLTAGE/PHASE				
	115V/1ph	230V/1ph	200V/3ph	230V/3ph	460V/3ph
00	0.33	1	1.5	1.5	2
0	1	2	3	3	5
1	2	3	7.5	7.5	10
2	-	7.5	10	15	25
3	-	-	25	30	50
4	-	-	40	50	100
5	-	-	75	100	200

C. Combination Motor Starters and Disconnect Switches: Provide combination motor starters and disconnect switches that meet the requirements of the "Motor Starters" article above. Combination motor starters and disconnect switches shall be used unless otherwise noted or prohibited by NFPA 70.

D. Manual Motor Switches: Provide manual motor switches for fractional horsepower fan, blower and pump motors that do not require automated start and stop functions.

E. Furnish and install devise fuses per equipment unit nameplate.

F. Size and adjust circuit breaker disconnect switches per equipment unit nameplate.

G. Electrical Connections: All electrical connections shall be made in accordance with equipment manufacturer's recommendations and in accordance with NFPA 70. Install and ground equipment connections in accordance with the requirements of NFPA 70 and Division 26.

1. Electrical Connections, Low Voltage (100 to 600 V): Division 23 contractor is responsible for power wiring and conduit from the equipment connections to the disconnecting means. Division 26 is responsible for the power circuit from the power source to the disconnecting means.

2. Electrical Connections, Control Voltage (Up to 24 V): Division 23 contractor is responsible for all control voltage wiring and conduit for HVAC equipment and controls from the low voltage power source disconnecting means. Division 26 is responsible for the low voltage power circuit from the power source to the disconnecting means.

    a. Low Voltage Disconnecting Means: Where dedicated low voltage circuits are indicated in Division 26 documents, the disconnecting means shall be defined as the disconnect switch or junction box provided. Where dedicated low voltage circuits are not explicitly indicated in Division 26 documents, the disconnecting means shall be defined as 20A/1P spare circuit breakers in panelboards.

H. Wiring Pathway, Low and Control Voltage: All low and control voltage power and control wiring shall be installed in conduit unless otherwise noted.

1. Surface-mounted raceway may only be used when indicated or Engineer approved prior to installation. In most cases, conduits shall be installed within walls, above ceilings and below floor slabs. Cut and repair substrates to install raceway.

2. Control voltage cabling shall be plenum-rated and organized with J-hooks when control cabling is not required by the Engineer to be installed in conduit.

I. Conduit:

1. Flexible Connections: Provide flexible connections for all vibrating equipment including fans, pumps, compressors, etc. Flexible connections shall be no more than 24-inches long.

2. Areas Subject to Damage: In areas where the conduit will be exposed and is subject to damage, such as mechanical equipment rooms, RGS conduit shall be installed to no less than 8-feet above finished floor and EMT may be used above 8-feet.

J. Grounding and Bonding: Ground and bond equipment and circuits in accordance with the requirements of NFPA 70 and Division 26.

K. Install duct-mounted smoke detectors, furnished and wired by Division 26. Provide duct access doors for proper maintenance and access.

L. Smoke-rated life-safety dampers shall be wired and controlled by Division 26.

M. Smoke control system devices shall be wired and controlled by Division 26.

3.2. FIELD QUALITY CONTROL

A. Comply with NFPA 70E per OSHA 29CFR Part 1910.5, Appendix A.

3.3. DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain electrical devices.

END OF SECTION 230511