SECTION 230910 - VARIABLE FREQUENCY DRIVES

PART 1-GENERAL

1.1 SCOPE

A. This specification describes the electrical, mechanical, environmental, agency and reliability requirements for three phase, adjustable frequency drives as specified herein and as shown on the contract drawings. Drives shall be furnished and mounted as shown on plans for pumps and shall be mounted on the air handling units. Drives shall be provided to Air Handler Unit manufacturer for mounting at factory. Drives used throughout the project site shall be provided by the same manufacturer for all applications (fans and pumps).

1.2 REFERENCES

A. The variable frequency drives and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of IEC, UL, CUL, NEC, IEEE, ANSI, and NEMA.

1.3 SUBMITTALS - FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Architect.

1. Dimensioned outline drawing.

2. Schematic diagram.

3. Power and control connection diagrams.

4. Inventer efficiency and power factor curves.

5. Performance curves.

6. Sustentative data for Mean Time Between Failure (MTBF).

1.4 QUALIFICATIONS

A. The supplier of the assembly shall be the manufacturer of the electromechanical power components used within the assembly, such as bypass contactors when specified.

B. For the equipment specified each drive shall be UL listed.

C. Audible motor drive noise shall be within 5 db of across line noise operation.

1.5 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall include the following information:

1. Instruction books

2. Recommended renewal parts list.

3. Drawings and information required by section 1.03.

1.6 WARRANTY

A. All equipment shall be warranted for one year on all labor and materials.

PART 2-PRODUCTS

2.1 MANUFACTURERS

A. Cutler-Hammer

B. Allen-Bradley

C. Toshiba

D. ABB

E. Reliance Electric

F. Danfoss

G. Square D

H. Trane

I. Yaskawa

Naming specific venders does not imply acceptance of their standard products nor relieve them from meeting these specifications in their entirety.

2.2 ELECTRONIC REQUIREMENTS

A. Each drive shall be microprocessor based, fully transistorized with 3 phase, full wave diode bridge input, and pulse-width-modulating sine-coded output waveform.

B. Output transistors shall be of the Insulated Gate Bipolar Transistor (IGBT) type.

C. Minimum 20 years MTBF required.

D. Maximum switching frequency of 15 KHZ.

E. Displacement power factor shall be 0.98 or better over the entire operating frequency and load range.

F. Service Factors on belt driver sets - 1.35 minimum

G. Provide multiple V belts on fan motors > 5 HP

2.3 PROTECTIVE FEATURES

A. Drive enclosure shall be NEMA 1 and shall be wall-mount or free standing as indicated on the Drawings.

B. Controlled acceleration and deceleration shall be adjustable from 3 to 600 seconds. Current limits shall prevent overflow trips.

C. Minimum switching frequency shall be adjustable from 0 to 100 percent of base frequency.

D. Maximum switching frequency shall be adjustable from 110 to 0 percent of base frequency.

E. Automatic boost for 100 percent starting torque.

F. Hand-off-auto switch mounted in front door of mounting enclosure.

G. Fault contact for remote indication.

H. Contact closure for remote indication that drive is operating.

I. Automatic restart on fault that is programmable for 0 to 5 restarts.

J. Minimum of 2 critical frequency avoidance points with programmable deadband.

K. Output signal for motor speed shall be 0 to 10 vdc or 4-20 milliamp.

L. Output voltage regulation.

M. Continued operation of drive at 80 percent of last speed reference input if control command is lost.

2.4 OPERATION PROTECTION

A. Current limit control for protection against normal transients and surges from incoming power lines, grounding systems, or runaway incoming speed reference signal.

B. Protection from phase-to-phase and phase-to-ground faults.

C. Torque limit control.

D. Capabilities to start into a spinning load and wind milling operation.

E. Instantaneous overcurrent trip to monitor peak currents and provide shutdown without component failure.

F. Input line reactors with a minimum of 3 percent rating on all incoming phase lines.

G. DC link choke to reduce current and voltage harmonics reflected to the AC power supply.

2.5 OPERATING CONDITIONS

A. Unit shall comply to the following operating conditions:

1. Line voltage: +10 percent, -10 percent of rating.

2. Line frequency: + or - 5 percent

3. Overload: 100 percent

4. Ambient temperature: 0 degrees to 40 degrees C.

5. Altitude: 3,300 feet or less

6. Atmosphere: 95 percent relative humidity, noncondensing

7. Efficiency: 97 percent at 100 percent load, 100 percent base speed. 80 percent at 12.5 percent load, 80 percent speed.

8. Fundamental power factor shall be 0.98 at all speeds and loads.

B. Digital operator/keypad is required and shall include the following features:

1. Motor speed indication, in RPM, percent speed, or frequency (Hz)

2. Speed reference signal

3. Alpha-numeric fault trip annunciation

4. Output current

5. Output power

6. Output voltage

7. Bus voltage

C. Indicator lights as follows:

1. Power on light

2. Run light

3. VFD trip light

4. External fault light.

D. The mechanical contractor shall require a sheave change so that the fan motor is producing its full rated horsepower at a VFD speed of 100%.

E. The variable speed pumps and fans shall be factory balanced throughout the entire range of operation.

2.6 OPTIONAL FEATURES TO BE INCLUDED IN THE VFD'S

A. HMCP or thermal magnetic breaker to provide a disconnect means. Operating handle shall protrude from the door. The disconnect shall not be mounted on the door. The handle position shall indicate ON, OFF, and TRIPPED condition. The handle shall have provisions for padlocking in the OFF position with at least three (3) padlocks. Interlocks shall prevent unauthorized opening or closing of the VFD door with the disconnect handle in the ON position. This shall be defeatable by maintenance personnel.

B. Three contactor bypass shall include a drive input disconnect, a VFD input isolation contactor, bypass contactor and a VFD output contactor that is electrically and mechanically interlocked with the bypass contactor. This circuit shall include control logic, status lights and motor overcurrent relays. The complete bypass system (Inverter-Off-Bypass) selector switch, and inverter/bypass pilot lights shall be packaged with the VFD. The unit may be set up for Manual bypass operation upon a VFD trip.

C. AC output contactor to provide a means for positive disconnection of the drive output from the motor terminals.

D. Laminated plastic or steel nameplate engraved with user's identifying name or number for oversize enclosures.

E. 120 Vac control to allow VFD to interface with remote dry contacts.

F. Motor overcurrent relay to provide motor overcurrent sensing of a given level of load current.

G. All three phase motors shall be protected with Phase Loss protection. Protection shall be provided by the electrical systems, built-in protection, or by protection built into a Variable Frequency Drive.

PART 3-EXECUTION

3.1 FACTORY TESTING

A. The following 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.

1. All printed circuit boards shall be functionally tested via automatic test equipment prior to unit installation.

2. All final assemblies shall be tested at full load with application of line-to-line and line-to-ground bolted faults. The Variable Frequency Drive shall trip electronically without device failure.

3. After all tests have been performed, each VFD shall undergo a burn-in test. The drive shall be burned in at 100% inductive or motor load without an unscheduled shutdown.

4. After the burn-in cycle is complete, each VFD shall be put through a motor load test before inspection and shipping.

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

3.2 FIELD QUALITY CONTROL

A. Provide the services of a qualified manufacturer's employed Field Service Architect or authorized service representative to assist the Contractor in installation and start-up of the equipment specified under this section. Field Service personnel shall be factory trained with periodic updates and have experience with the same model of VFD's on the job site. Sales representatives will not be acceptable to perform this work. The manufacturer's service representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, installation as specified in manufacturer's installation instructions, wiring, application dependant adjustments, and verification of proper VFD operation.

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 VFDs and spare parts.

3. The contractor shall certify that he has read the drive manufacturer's installation instructions and has installed the VFD in accordance with those instructions.

C. The Contractor shall provide three (3) copies of the manufacturer's field start-up report before final payment is made.

3.3 WARRANTY/TRAINING

A. Manufacturer shall warrant complete drive system for a period of one (1) year.

B. A factory trained representative shall provide a minimum of 8 hours on-site training to owner selected personnel on the operation and maintenance of each drive installed. This training shall be videotaped, with two (2) copies provided to the owner.

END OF SECTION 230910