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The Description of the Project
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SPECIFICATION DIVISION 22

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DIVISION 22 PLUMBING
SECTION 220514A - VARIABLE FREQUENCY DRIVES (CONSTANT TORQUE)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.

1.2 SCOPE OF WORK:

A. Provide variable frequency drives (VFD) with constant torque design for constant torque loads such as rotary air to air energy recovery wheels. VFD shall meet the requirements contained herein and as indicated in the VFD schedule.

1.3 QUALITY ASSURANCE:

A. VFD shall comply with NFPA 70 (National Electrical Code), IEEE 519, UL 508, NFPA 70, and FCC compliance for Radio Frequency Interference (RFI) and Electro- Mechanical Interference (EMI).

1.4 WARRANTY:

A. Provide a minimum of 3 years parts and labor warranty from the date of final acceptance by the University.

1.5 ACCEPTABLE MANUFACTURERS:

A. Variable frequency drives (constant torque) shall be manufactured by one of the following: ABB, Yaskawa. VFDs manufactured by parent companies or their subsidiaries are not acceptable.

1.6 SUBMITTAL DATA

A. Submit for approval, the following product data:

1. Dimensions and elevations.
2. Complete product data listing all included features.
3. The electrical rating for each VFD, matched to each piece of driven equipment.
4. Short circuit current (withstand) rating.
5. Project specific wiring diagrams indicating:
   a. Line/load connection points
   b. Main input and inverter input disconnect switches
   c. Fusing/circuit breakers
   d. Safety interlock, run permissive, and drive initiated external circuits
   e. Analog inputs and outputs
   f. Each wire on the wiring diagram shall be labeled with a distinct wire identifier.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Provide minimum 6 pulse PWM type drives.

B. VFDs designated for installation indoors shall have enclosures rated NEMA 1. VFDs designated for installation outdoors shall have enclosures rated NEMA 3R minimum.

C. The VFD shall be capable of operation at the maximum ambient temperature at the drive location without derating.

D. The VFD shall have an overall short circuit current (withstand) rating of _____ amps symmetrical minimum, and shall be marked with its short circuit current rating in compliance with UL.

E. The unit, including all specified accessories, shall have a minimum efficiency of 85 percent at any speed from 50 to 100 %. The unit shall have a power factor of 0.9 or higher when operating at any speed from 50 to 100%.

F. The VFD shall be constant torque type and shall provide full motor torque at any operating speed from 2% to 100%.

G. The unit shall include self diagnostics with a digital display that identifies fault conditions and simplifies trouble shooting. Fault indication shall be retained even after a power outage or an input over-current protective device trip.

H. Unit shall be UL, CSA or ETL labeled.

I. The unit shall have a dedicated terminal block for all external inputs and outputs.

J. The VFD voltage and phase shall match the line and load voltage and phase indicated on the drawings.

2.2 CONTROL FEATURES:

A. The VFD shall be provided with the following control features:

1. Manual speed potentiometer or keypad control, for local speed control.
2. A VFD controller with a man/machine interface (MMI)consisting of a back-lit liquid crystal (LCD) display and labeled push buttons or a touch screen. The MMI shall provide access to view and set all drive functions, including the following required functions:
   a. Adjustment of drive speed at the MMI, when the VFD controller is set for local control.

3. The controller/MMI shall display, at minimum, the following parameters:
   a. Motor speed indication including RPM, GPM, CFM units.
   b. kWh
   c. Power
   d. Horsepower

e. Output amperage, per phase
f. Output voltage
g. Output frequency
h. Input reference signal
i. Speed and start/stop controlled locally or remotely
j. Fault warning messages
k. Drive fault cause
l. Acceleration and deceleration rate
m. Frequency lock-outs

4. The VFD shall accept an input reference signal, 0-10 Vdc analog or 4-20 mA analog, as indicated in the VFD schedule, for remote speed control. Provide input signal isolation to isolate input signal ground from VFD internal control ground.
5. A remote start/stop contact input that functions in the automatic mode only.
6. A safety interlock circuit that functions in drive mode.

7. A standard USB port for direct connection of a Personal Computer (PC) to the VFD. The manufacturer shall provide PC software to allow complete setup and access to the VFD through the USB port. It shall be possible to communicate to the VFD through this USB port without interrupting VFD communications to the building management system

8. A real-time clock shall be an integral part of the VFD.
   a. It shall be possible to use this to display the current date and time on the VFD's display.
   b. The clock shall include a time clock function with 7 day programmability and a minimum of four programmable time periods per day, with individually selectable ON and OFF functions. The time clock function shall be programmable to control start/stop functions, constant speeds, PID parameter setpoints and output relays. The time clock function shall be programmable through the controller display and keypad, or by included software that allows programming via a PC and a USB connection.

9. VFD shall automatically attempt to restart a minimum of three (3) times during an adjustable time period of no less than 30 seconds after shutting off for any reason, except for short circuit or motor overload.
10. The VFD shall have adjustable motor acceleration and deceleration rates.
11. The VFD shall have the ability to lock-out a minimum of four critical frequency ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment.
12. Provide the ability to program a minimum of 12 preset speeds, selected by the drive, when started by a digital input.
13. Provide a minimum of one 4-20 mA analog output signal selectable to proportionally indicate drive output frequency, current, or power, or to indicate the VFD input reference signal, for monitoring by DDC.

2.3 SAFETIES:

A. Provide status lights or digital display indication at the MMI of the cause of any shutdown.

B. The VFD shall be provided with the following safety features:

1. VFD over voltage and under voltage protection and protection against temporary power outages.
2. VFD over temperature protection.
3. Motor over temperature protection per NEC 430.126(A)(2).
4. Short circuit and ground fault protection.
5. Separate motor overload protection for normal operation.
6. Adjustable current limiter.

2.4 LABELING:

A. Provide permanently attached labels to the VFD panel face indicating the function of all switches and indicators, and the equipment served.

B. Tag all wiring in the drive. Tag nomenclature shall match the corresponding wire identification nomenclature indicated on the approved drive submittal.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Unit installation, including mounting and supports, and wiring to motor shall be by the Electrical Contractor, in compliance with Division 26. Coordinate with the Electrical Trades and Control Trades as required.

B. Install the VFD as close as possible to the motor. The load side power cables to the motor shall be kept as short as possible and shall not be run in the same conduit as the line side power cables. Control wiring shall be in separate conduit from power wiring. Where applicable, control wires from the motor disconnect early break contacts may be installed with the motor power wiring.

C. Protect the unit from dirt, dust, water and physical damage prior to and during construction. If the inside of the unit becomes dirty or dusty before acceptance by the University, it shall be thoroughly cleaned by the unit manufacturer at the contractor's expense.

3.2 CHECK, TEST AND START:

Provide the services of a factory trained and certified technician to supervise check, test and start. The contractor shall notify U of M representative 5 days in advance of the start-up.

END OF SECTION 220514