

## SECTION 26 29 23 – VARIABLE FREQUENCY DRIVE UNITS

### PART 1 - GENERAL

#### 1.1 THE REQUIREMENT

- A. General: The CONTRACTOR shall provide variable frequency drive (VFD) units, complete and operable, in accordance with the Contract Documents. It is the intent of this Section to require complete, reliable, fully tested variable frequency drive systems suitable for attended or unattended operation.
- B. The requirements of Section 26 05 00 – Electrical Work, General, apply to the WORK of this Section.
- C. Single Manufacturer: Like products shall be the end product of one manufacturer in order to standardize appearance, operation, maintenance, spare parts, and manufacturer's services. This requirement, however, does not relieve the CONTRACTOR of overall responsibility for the WORK.

#### 1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6.
- B. Shop Drawings: Shop Drawings shall include the following information:
  - 1. Equipment information
    - a. Name of drive manufacturer
    - b. Type and model with complete catalog number and explanation
    - c. Assembly drawing and nomenclature
    - d. Maximum heat dissipation capacity in kW
  - 2. Enclosure rating.
  - 3. Operator interface information
  - 4. Conduit entrance provisions.
  - 5. Circuit breaker type and rating requirements.
  - 6. UL listing.
- C. The Technical Manual shall contain the following documentation:
  - 1. Manufacturer's 2 year warranty.
  - 2. Field test report.
  - 3. Programming procedure and program settings.
- D. Spare Parts List: Information for parts required by this Section plus any other spare parts recommended by the controller manufacturer.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. The CONTRACTOR shall provide variable frequency drives for the following centrifugal pumps:

Facility	Equipment	Enclosure	Pump HP	Drawing

- B. The CONTRACTOR shall provide variable frequency drives as shown on the Drawings.

### 2.2 EQUIPMENT

A. VFD

1. Shall be an adjustable frequency inverters
  - a. designed to operate at 208, 240, 480V 3 phase or convert incoming 1-phase, 240 volt, 60 Hertz power to a DC voltage and then to adjustable frequency 3-phase AC by use of a 3 phase inverter as shown on the drawings.
  - b. The inverter shall be a voltage source design producing a pulse-width-modulated type output.
  - c. Inverters shall be designed to operate 3-phase, 60 Hertz, NEMA-B, open drip-proof (1.15 SF) or TEFC (1.15 SF), squirrel-cage high efficiency inverter duty induction motors over the range of 50-100 percent of base speed without derating (other than for single phase source) or requiring any motor modifications.
  - d. Inverters shall be capable of delivering nameplate horsepower exclusive of service factor without the need for mandatory thermostats or feedback tachometers.
  - e. The VFD shall vary both the AC voltage and frequency simultaneously to operate the motor at required speeds.
  - f. Current source inverters will not be acceptable.
  - g. Inverters shall be sized to match the KVA and inrush characteristics of the motors.
2. The CONTRACTOR shall be responsible for matching the controller to the load (variable torque) as well as the speed and current of the actual motor being controlled, including over-sizing of the drive for the single-phase input.

- B. NEMA 4X Enclosure: Drives designated as NEMA 4x shall have a wall-mounted, IP66-rated, NEMA 4X integral enclosure with external heat sink for installation in a harsh environment without the use of a separate enclosure. The drive enclosure shall provide protection against high-pressure water spray, corrosion, and dust.
- C. NEMA 1 Enclosure: Drives designated as NEM1 shall have a wall-mounted IP66-rated NEMA 1 integral enclosure with external heat sink for installation without the use of a separate enclosure.
- D. The minimum VFD inverter efficiency shall be 95 percent at 100 percent speed and load, and 85 percent at 50 percent speed and load.
- E. The VFD shall shut down in an orderly manner when a power outage occurs on one or more phases. Upon restoration of power and a "start" signal, the motor shall restart and run at the speed corresponding to the current process input signal.
- F. The VFD shall be provided with additional features described below:
  - 1. Inrush current adjustment between 50 and 110 percent of motor full load current (factory set at 100 percent).
  - 2. Overload capability at 110 percent for 60 seconds for variable torque loads.
  - 3. Adjustable acceleration and deceleration.
  - 4. On loss of input signal, the VFD shall operate at a preset speed or hold last state at time of signal loss.
  - 5. A minimum of 2 selectable frequency jump points to avoid critical resonance frequency of the driven system.
  - 6. 3 percent line reactor on the output when indicated on the drawings.
- G. Protection: The VFD shall have, as a minimum, the following protection features:
  - 1. Input line protection provided with metal oxide varistor (MOV) and RC network.
  - 2. Protection against single phasing.
  - 3. Instantaneous overcurrent protection.
  - 4. Electronic overcurrent protection.
  - 5. Ground fault protection.
  - 6. Overtemperature protection for electronics.
  - 7. Protection against internal faults.
  - 8. Ability to start into rotating motor (forward or reverse rotation).
  - 9. Additional protection and control as indicated and as required by the motor and driven equipment.
- H. Service Conditions: The VFD shall be designed and constructed to satisfactorily operate within the following service conditions.
  - 1. Ambient temperature: 0 to 40 degrees C
  - 2. Humidity: 0 to 95 percent, non-condensing
  - 3. AC line voltage variation: plus 10 percent to minus 10 percent.
  - 4. AC line frequency variation: plus and minus 2 hertz.

- I. Operator Interface: The drive shall have an operator interface with LCD display and full numeric keypad. The operator interface shall be accessible from the front of the enclosure without opening any doors.
- J. DeviceNet Bridge: The inverter signal circuits shall be isolated from the power circuits and be designed to accept a DeviceNet interface. The drive supplier shall provide an EDS file to allow the Allen-Bradley Devicenet programming software to address the drive. The inverter shall follow the setting of a local control when in the hand mode. The following operator monitoring and control devices for the inverter shall be provided on the face of the VFD enclosure, either as discrete devices, or as part of a multi-function microprocessor-based keypad access device. Access to set-up and protective adjustments shall be protected by key-lockout or password.
  - 1. All available programming parameters must be addressable from RSNetworkx over DeviceNet without the use of protocol convertors or bridges.
  - 2. Auto/Hand selection from the operator interface. In "Auto", the inverter shall operate from the DeviceNet input, and in "Hand" control, shall operate on Devicenet from the local keypad.
  - 3. Speed indicator calibrated in percent speed
  - 4. Inverter fault trip indication and output alarm contacts
  - 5. Trip reset pushbutton
  - 6. Electronic overload protection.
- K. Properly identified screw type terminal boards shall be provided for interconnection to remote controls.

## 2.3 POWER CONDITIONING

- A. Where shown on the drawings the CONTRACTOR shall provide:
  - 1. Line Reactor: Line reactors shall be designed for use as output filters for AC-PWM VFDs. The windings shall be copper with 600VAC Class H insulation, bobbin construction, laminated iron core, and rated for 200 percent capacity for 3 minutes. The reactors shall be enclosed in a NEMA 1 enclosure and include wire terminals, and be UL-listed. The reactors shall be **Trans-Coil Inc. Model KLR**, or equal.
  - 2. Load Reactors
    - a. For lead lengths less than 100 feet **TransCoil Inc. Model KDR**
    - b. For Lead Lengths 100feet and over **TransCoil Inc. Model V1K**

## 2.4 SPARE PARTS

- A. The CONTRACTOR shall furnish the spare parts listed below, suitably packaged and labeled with the corresponding equipment number.
- B. The following spare parts shall be furnished:
  - 1. Three (3) sets of spare fuses of each size.
  - 2. One (1) spare Devicenet interface card.
  - 3. One (1) spare keypad access device (HIM).

4. The OWNER currently has spare parts for Allen-Bradley drives. Unless the CONTRACTOR is providing Allen-Bradley drives, the CONTRACTOR shall provide 10% spares of the drives installed under this Contract and at least one (1) driver of each size.

## 2.5 MANUFACTURERS

- A. The variable frequency drive units for 240V single phase to 7.5HP or less and 3 phase over 7.5HP motors shall be **Allen-Bradley Powerflex 700**, or equal.
- B. Panel size is based on Allen-Bradley drives. CONTRACTOR shall make all necessary modifications required for other drives.

## PART 3 - EXECUTION

### 3.1 SERVICES OF MANUFACTURER

- A. General: An authorized service representative of the manufacturer shall be present at the sites as necessary to furnish the inspection, startup, and field adjustment services listed below.
- B. Inspection, Startup, Field Adjustment: The authorized service representative shall supervise the following and certify the equipment and controls have been properly installed, aligned, and readied for operation.
  1. Installation of the equipment
  2. Inspection, checking, and adjusting the equipment
  3. Startup and field testing for proper operation
  4. Performing field adjustments such that the equipment installation and operation comply with requirements.
- C. Instruction of OWNER's Personnel: The authorized representative shall instruct the OWNER's personnel in the operation and maintenance of the equipment, including step by step troubleshooting with test equipment. Instruction shall be specific to the VFD models provided.
- D. Telephone Support: The drive Manufacturer shall provide one (1) year of telephone technical support for the Owner during normal business hours. The technical support shall include the drive, HIM, and Devicenet, and shall start on the date of substantial completion.

### 3.2 INSTALLATION

- A. Conduit stub-ups for interconnected cables and remote cables shall be located and terminated in accordance with the drive manufacturer's recommendation.
- B. Drives shall be mounted a minimum of 1-1/2 inches from any wall surface.

- C. Strut supports for drives shall not be mounted directly to wood surfaces. Install ½-inch thick cement board (Dura-rock or equal) to the wood surface, a minimum of 2 inches larger than the drive outline all around.
- D. The CONTRACTOR shall perform programming of drive parameters required for proper operation of the VFD's included in this project. Submit records of programming data in the equipment Technical Manual, including setup and protective settings

### **3.3 FIELD TESTING**

- A. Testing, checkout, and startup of the VFD equipment in the field shall be performed under the technical direction of the manufacturer's service engineer. Under no circumstances shall any portion of the drive system be energized without authorization from the manufacturer's representative.

**END OF SECTION 26 29 23**