

SECTION 26 29 23 - VARIABLE SPEED DRIVES

PART 1 GENERAL

1.1. SUMMARY:

- A. This section details general requirements for Variable Speed Drives (VFD's) used for the operation and control of electric motors.

1.2. RELATED SECTIONS:

- A. Section 01301- Design Guidelines for Energy and Environment
- B. Section 01351- Electric Rebate Program
- C. Section 01701 - Building Systems Identification and Labeling
- D. Section 01771 - Contract Record Documents
- E. Section 26 00 10- Electrical Design Criteria

1.3. QUALITY ASSURANCE:

- A. The Engineer shall ensure the VFD application meets the recommendations contained in IEEE Standard 519 with regard to harmonic distortion.
- B. Harmonic analysis studies shall be performed for all large motor loads (over 50 HP) or large quantities of smaller motor loads to verify compliance, or where VFD's are added to existing services with high harmonic content. The building primary service entrance shall be considered the Point of Common Coupling (PCC) for establishing current harmonic limits. Total harmonic voltage distortion (THD) shall not exceed 5% at any point in the building distribution system, except in separately derived systems dedicated to the harmonic producing equipment.
- C. VFD Design shall include defined connection points and shall address termination, programming, integration, and start-up responsibilities.
- D. VFD's shall be UL listed and labeled as an assembly, and marked for intended use.
- E. VFD's shall be provided with options and accessories to qualify for National Grid Rebate Programs.

1.4. SUBMITTALS:

- A. Submit the following documents for reference and/or approval:
 - 1. Power three-line and complete logic/controls drawings.
 - 2. A list of all factory and field setpoint values.
 - 3. Addressing, sequence of operations, Input/Output hardwire and data communications connections to BAS, Fire Alarm System, remote field devices and the VFD configurations that are loaded by keypad or PC.
 - 4. Complete installation, operation, troubleshooting and maintenance manuals.

1.5. WARRANTY:

- A. 5 Years from the date of certified start up. Include all parts, labor, travel time and expenses.

1.6. VARIABLE SPEED DRIVE GENERAL REQUIREMENTS:

- A. VFD's shall be variable torque, variable voltage/frequency type for centrifugal fan and pump applications, suitable for use with both standard and high efficiency 3-phase, squirrel cage, induction motors.
 - 1. VFD's shall have the following features and operational requirements: Auto restart after a power line transient (over or under voltage, or power loss) when the power line returns to normal.
 - 2. Auto restart after selected drive faults. The number of restart attempts shall be adjustable at the drive for zero, one or two.
 - 3. Internal drive control shall be fully field programmable without external hardware.
 - 4. "On-the-fly" restart into a coasting load. Resynchronization shall not require more than 150% current.
 - 5. Auto/off/manual switch; manual local speed control; adjustable current limit, adjustable acceleration and deceleration rates; remote start/stop for automatic control. It shall not be necessary to stop the drive when toggling from remote to local speed control.
 - 6. Capable of accepting external, permissive contacts such as a freezestat, static pressure safety, damper end switch and fire alarm shutdown contacts to de-energize the motor whether the drive is in automatic, manual drive, or bypass mode.
 - 7. Dedicated "Fireman's override" external contacts for programmable VFD operation to a preset speed setting for smoke purge or emergency reduced power operation.
 - 8. Programmable auxiliary output dry contacts (2 N/O, 2 N/C each) to indicate: drive run, bypass run or to control devices such as damper open/close.
 - 9. Isolated 4-20mA speed input follower and speed feedback circuits.
 - 10. EIA-485 and EIA-232 communications ports, for BACNET communications card interface with Building Automation Systems (BAS).
 - 11. 5% Input line reactors for harmonic suppression.
 - 12. External three-contactor DRIVE/OFF/BYPASS/TEST SWITCH that allows operation of the motor via line power in the event of VFD failure.
- B. VFD to be provided with 3-contactor type bypass, configured as follows:
 - 1. Controls shall be configured to allow system operation in bypass mode without damage to equipment, pipes, ductwork, etc.
 - 2. Bypasses shall be remotely and locally controlled using a 3-contactor transfer scheme and a three wire bypass start/stop scheme.
 - 3. Indicating lights shall be provided for all functions.
 - 4. Allow for servicing and operational testing of the drive while operating on bypass.
 - 5. Bypasses shall include short circuit protection and separate electronic-type motor overload devices.
- C. VFD's shall include the following protective requirements:
 - 1. Input circuit-breaker type disconnect, pad-lockable type.

2. Minimum VFD short circuit protection rating of 65KAIC at both 480 VAC and 208VAC.
 3. Ground fault protection.
 4. Output overcurrent trip.
 5. Motor thermal protection with RTD capability over 100 hp.
 6. Stall protection.
 7. Drive over temperature.
 8. Under voltage trip.
- D. Provide VFD and bypass within common enclosures, with ratings based on environment:
1. Indoor dry environments; NEMA1, ventilated type.
 2. Indoor dirty or dusty environment: NEMA 12 gasketed, with filters or external heat exchanger.
 3. Outdoor or wet environments: NEMA 4x.

1.7. VFD DESIGN CONSIDERATIONS:

- A. Show VFD locations on mechanical plans. Ensure adequate mounting space and floor area including service access. VFD preferred location is adjacent to and within the same room as equipment served.
- B. Drive Rating: VFD's shall be capable of continuous operation at a minimum of 100% of motor nameplate rating, including the service factor.
- C. The Engineer of Record shall review harmonic effects of VFD's on Building service. VFD's using six-pulse conversion technology is typically acceptable for installation in most facilities. Utilize 12 or 18-pulse conversion technology for motor loads over 50 HP where:
 1. Sensitive research equipment may be affected by harmonic distortion,
 2. VFD's will be operated from standby generators,
 3. Building service size is small in relation to overall VFD loads.
- D. Electrical Service: Feed the drive directly from the main building switchboard or from a feeder that is dedicated to mechanical loads. Isolation transformers or line reactors may be considered on installations where Total Harmonic Distortion (THD) limits cannot be achieved as described above.
- E. The Engineer of Record shall determine the maximum acceleration and deceleration rates for driven loads. If necessary, drives will be oversized or provided with braking to meet these requirements.
- F. Isolation transformers or reactors shall not be in the drive circuit when operated in bypass, except in the case where a transformer is needed to change voltage.
- G. All control wiring should be shielded wire and installed in separate conduit from power wiring.
- H. In applications where the drive will be more than 100 cable feet from the motor, coordinate with the motor manufacturer to ensure that the motor is suitable for the application, or to provide a motor protecting dV/dT filter on the drive output to

protect the motor.

- I. Specify one full set of spare fuses in each drive.

PART 2 - PRODUCTS:

2.1 VARIABLE SPEED DRIVES:

- A. Manufacturers:
 1. ABB
 2. Toshiba
 3. Mitsubishi

PART 3 - EXECUTION:

3.1 GENERAL:

- A. Ensure that VFD programming and motor protective devices are properly calibrated and set.
- B. Provide hardcopy of all VFD program settings, wiring diagrams and Operating manual within the VFD cabinets.
- C. Include copy of all VFD program settings, wiring diagrams and Operating manual with project O & M Manual.
- D. Clean interior of VFD enclosures at completion of installation.
- E. Machine-Label VFD with equipment served, VFD operating voltage, and source power panel and circuit number.

3.2 START-UP:

- A. A factory-trained and certified technician shall check the installation, program and start the VFD's and place them into operation.
- B. Provide certified start-up report for each VFD.

3.3 TRAINING:

- A. Provide On-site instruction with each VFD via a Factory trained and certified instructor.
- B. All training aids shall be provided by trainer. Content to include care, troubleshooting, servicing, and operation of the equipment and systems installed.

END OF SECTION