

VARIABLE FREQUENCY DRIVES

GENERAL INFORMATION

- 1.1 This section applies to Variable Frequency Drives (VFD's) also know as Variable Frequency Controllers, Variable Speed Drives, and Variable Speed Controllers.

DESIGN REQUIREMENTS

- 2.1 Approved manufacturers:
 - a. ABB
 - b. Yaskawa
- 2.2 VFD's shall be pulse width modulated (PWM) inverter type designed for use on a standard NEMA Design B induction motor, and shall be equipped with:
 - a. NEMA 12 enclosures. Provide NEMA 3R, minimum, for outdoor or wet area installations, including running under or near mechanical piping.
 - b. HOA switch and normal/bypass switch in the front of the cabinet (separate from the keypad functions).
 - c. Factory supplied terminals inside the enclosure for all field connected devices. Wire nuts are not allowed inside the enclosure. Control wires that need to be joined inside the enclosure shall be landed on terminal blocks with the wires marked appropriately.
 - d. Highest efficiency and power factor ratings available in the industry.
 - e. Input disconnects or circuit breakers. Short circuit rating shall be 100K AIC.
 - f. Ability to communicate with RS-485 Modbus/RTU.
 - g. Means to limit harmonic contribution onto the supply system. This can be done by using 18 Pulse Drives, 12 Pulse Drives with a 3% line reactor or 6 Pulse drives with input harmonic filters. Harmonic mitigation is not required for motors 20HP and less. 24 Pulse Drives are required for VFD's serving motors over 600 volts. As a minimum, where the total VFD load being added makes the total load on a substation or service entrance greater than 75% of the nominal rating, provide analysis indicating that the harmonic generating loads being added (with harmonic mitigation equipment above) will not overload the transformer or the service entrance and will comply with IEEE 519 (latest version).
 - h. A bypass circuit configured to start the motor and operate at full frequency with the drive isolated from the circuit by means of a 3 contactor or 2 contactor and service disconnect arrangement. Bypasses for large motors that will cause an undesirable voltage drop when started across the line shall be fitted with Reduced Voltage Solid State (RVSS) starters with adjustable torque and current limitation in the bypass circuit. This does not apply to VFD's for motors over 600 volts where not readily available. Where is can be shown that sufficient redundancy is provided in the mechanical system (standby pumps, etc) so that a VFD can be taken out of service

without affecting the driven load, bypasses may be deleted only with written request and permission from the CU Facilities.

- i. Bundled, tie-wrapped and supported factory wiring within the enclosure.
- 2.3 Coordination: Coordinate the features, accessories, and functions of each VFD with ratings and characteristics of supply circuit, motor type and size, required control sequence and duty cycle of motor. Coordinate all VFD's with the Trade supplying related systems including the requirements for interlocking with building automation systems.
- 2.4 All components shall fit into the vendor's engineered cabinet so that no field wiring or auxiliary component is required. Unit shall be shipped from the vendor as a single unit that is UL listed as a complete assembly
- 2.5 VFD's shall be located at the motor served. Where the distance between the motor and drive is between 100 and 300 feet away from motor, provide output reactors on the VFD. Where distance is great than 300 feet provide dv/dt filters or provide written confirmation from the VFD vendor that an output reactor is sufficient for the specific installation.
- 2.6 BMS control shall be through hardwired connection. Serial communications shall be for monitoring only. At a minimum, VFD shall have VFD speed control, speed feedback, start/stop, not-in-auto mode, drive in bypass mode and common alarm hardwired communication.
- 2.7 All disconnect switches provided at the motor downstream of the VFD shall be equipped with early break- late make contacts to tie back to the VFD.

CONSTRUCTION REQUIREMENTS

- 3.1 All VFD's shall be installed to maximize clearance required for maintenance and troubleshooting.
- 3.2 Provide concrete bases for freestanding VFD's, regardless of whether mounting legs are provided to facilitate floor mounting.
- 3.3 Each enclosure shall be furnished with a schematic wiring diagram specific to its installation with all options and field connected devices on the inside of the door.
- 3.4 Certified factory training shall be provided for Operations Personnel by a factory authorized service center. Instruction shall be done at the convenience of the Owner and shall include a description of all the functions of all indicators and controls and a demonstration of the following:
 - a. Normal operating procedures – Automatic mode
 - b. Normal starting, stopping, speed control procedures – Manual operation mode
 - c. Bypass mode operation
 - d. Emergency shutdown
- 3.5 Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive.

END OF SECTION