15960-H: SUPPLEMENTAL VARIABLE SPEED DRIVES GUIDELINE FOR UMHHC FACILITIES

Related Sections

Basis Guideline: 15960 - “Variable Speed Drives”
For an explanation of the use of these guidelines, see SID-A-H “Design Guidelines for UMHHC Facilities”

In addition to UMAEC basis guideline 15960, UMAEC Specification 15960 shall also be considered as part of 15960H basis. UMAEC specifications are located on website http://www.plantext.bf.umich.edu/for.archs/masterspec.html. All information presented in the reference UMAEC specification applies to UMHHC facilities, unless explicitly stated otherwise below. Where difference and/or conflicts exist between the UMHHC supplemental information noted below, and the information in the UMAEC guideline and/or specification, this supplementary information shall take precedence.

Standards

The overall VFD (starter) shall be tested to ANSI/UL standard 508. The complete drive, including all supplied options shall be listed and labeled by a nationally recognized testing agency such as UL or ETL.

The VFD shall meet FCC Part 15 Subpart J limits on radio frequency interference and also carry a FCC compliance label.

General

For the purposes of these guidelines, the terms variable speed drive and VSD, can and may, be used interchangeably with the terms variable frequency drives and VFD.

Reference UMHHC ‘Preferred Manufacturer’s List’ for acceptable VFD manufacturers.

Provide VFD with a main input fusible disconnect switch with current limiting fuses and fuse rejection clips. All other fuse blocks with current limiting fuses installed shall be equipped with fuse rejection clips.

The VFD shall include overvoltage (surge) protection, undervoltage (brownout) protection, an adjustable current limiter and automatic shutoff upon an output short circuit or motor overload.

If safe practice allows automatic equipment restart, VFD’s shall be wired and controlled through the BMS so that the motor automatically restarts after a power disruption.

Pilot lights shall be push-to-test, LED transformer type.

Before adding a VFD, evaluate the possible effects of the VFD on power factor correcting capacitors or harmonic sensitive equipment on the same bus. Avoid installing a VFD on the same bus with capacitors or ‘sensitive’ equipment. Sensitive equipment, as defined here, are loads adversely affected by harmonic voltage distortions. These include high sensitivity laboratory equipment, patient monitoring or treatment equipment, computers, etc.

Total Harmonic Distortion (THD) Considerations

The VFD shall limit the THD to the values noted below when operating at any load from zero to 100 percent.

- VSD input voltage waveform: less than 3 percent THD.
• VSD input current waveform: less than 20 percent.

After startup of the VSD, the University will measure the voltage and current THD to affirm compliance. There shall be no additional costs to the University for any additional reactors or filters required to reduce the actual THD to the calculated THD.

Harmonic Remediation Requirements: Unless otherwise noted below, VFD’s shall be at least supplied with a 5% line reactor filter integral to the drive. Neither the reactor nor any other filter shall be active, however, when the drive is operating in bypass mode.

• If ratio of supply transformer’s kVA, to motor HP being served, is equal to or greater than 80, then supply VFD’s with line reactor filters.
• If ratio of supply transformer’s kVA, to motor HP being served, is between 40 and 80, then meter the existing distribution system to determine level of voltage waveform THD. If voltage waveform THD is 2% or less, then supply VFD with 5% line reactor filters. If voltage waveform THD is more than 2%, then supply 18-pulse type VFD.
• If ratio of supply transformer’s kVA, to motor HP being served is equal to or less than 40, then supply 18-pulse type VFD.
• VFD’S for motors 100HP and greater shall be 18-pulse type regardless of supply transformer’s kVA to motor HP ratio.

If the total load on the transformer, after the additions of the current project, exceeds 75% of its rating and/or if the total harmonic generating load on a substation will exceed 50% the A/E shall prepare an IEEE 519 study for review by the University showing that the transformer can safely carry those loads. If the study shows the transformer inadequate, the project shall either increase the transformer size, or add additional transformers.

**Maintenance Bypasses**

All VFD’s for motors larger than 5 HP, and/or on systems serving critical loads (as defined in program statement), and/or systems that do not have a means of 100% backup/redundancy shall include full maintenance bypass systems. These bypasses shall be configured to allow operation of the motor in “across the line” mode while the drive is being repaired. Also, the bypass equipment shall be electrically isolated from the VFD drive equipment so that maintenance may be safely done with the motor running “across the line” in through the bypass.

The electrical system serving a VFD, and the mechanical system being served by the VFD, shall be sized and braced to allow that motor (and associated mechanical system) to start and operate properly and safely when in the bypass mode - across the line. Special attention needs to be given to the affects of the voltage drops during start and the ability of the upstream over current devices to carry the locked rotor current during the startup.

Evaluate the need, from an operator safety perspective, to provide an automatic bypass feature that automatically connects the motor directly across the line if the VSD faults or fails. An automatic bypass is commonly required for critical equipment such as fume hoods. When an automatic bypass is provided, motor overload protection and the safety circuits shall remain active with the VSD in automatic bypass.

**Motor Disconnect Switch**

Safety disconnect switches are not required at the motor, when the line disconnect of the VFD is lockable, and within sight of the motor. When the VFD line disconnect is not lockable, or is not in line-of-sight, a separate non-fusible safety disconnect shall be installed at the motor location. All safety disconnect switches shall have pre-break (auxiliary) control contacts, (even if they are not specifically required by the VFD supplier). The wires for this control contact shall be run in the same raceway as the power conductors. All wiring and grounding shall be in accordance with the associated electrical sections dealing with these requirements.
Installation Requirements

A. Ensure that the VFD is installed in accordance with manufacturer’s instructions, including instructions on special types of control wire.
B. If the VFD is free standing, locate it on a housekeeping pad. Provide a mounting rack, do not attach to housing of mechanical equipment.
C. Maintain the workspace around the VFD in accordance with the NEC.
D. Do not run conduit containing motor conductors near or across sensitive medical equipment or low voltage systems.