

# News to Use

## Design Requirements Manual

The formulae  $\frac{\partial \mathcal{L}}{\partial \alpha} + \frac{\partial}{\partial \alpha} (\mu \mathcal{L}) - \frac{\partial}{\partial \alpha} \left( \frac{\partial \mathcal{L}}{\partial \alpha} \right) + \mathcal{L}(\rho - \rho_0)$  for building  $\frac{\partial}{\partial \alpha} (\rho \mathcal{L}) - \frac{\partial}{\partial \alpha} \left( \frac{\partial \mathcal{L}}{\partial \alpha} \right) + \mathcal{L}(\rho - \rho_0)$  state of the art  $\frac{\partial}{\partial \alpha} (\rho \mathcal{L}) - \frac{\partial}{\partial \alpha} \left( \frac{\partial \mathcal{L}}{\partial \alpha} \right) + \mathcal{L}(\rho - \rho_0)$  biomedical research facilities.

'Design Requirements Manual (DRM) News to Use' is a monthly ORF publication featuring salient technical information that should be applied to the design of NIH biomedical research laboratories and animal facilities. NIH Project Officers, A/E's and other consultants to the NIH, who develop intramural, extramural and American Recovery and Reinvestment Act (ARRA) projects will benefit from 'News to Use'. Please address questions or comments to: [ms252u@nih.gov](mailto:ms252u@nih.gov)

### Variable Frequency Drive

Variable frequency drive (VFD) use has increased dramatically in past decades to reduce energy as most industrial and commercial motor applications do not require constant speed operation. In addition to energy savings, VFDs offer the following advantages: low motor starting current, high power factor, lower KVA and reduction of thermal and mechanical stresses on motors and belts during the starts. VFDs are commonly applied to air handlers, pumps, chillers and fans. Proper specifications and installations of VFDs are crucial for the prevention of premature failures and elimination of electrical nuisances.

The Design Requirement Manual (DRM) requires that VFD installation in the NIH facilities shall meet the following requirements:

- 1) Harmonic distortion on both supply and motor side of the VFD.
- 2) De-rating of equipment due to harmonic produced by VFDs.
- 3) Audible noise caused by high frequency (several KHz) components in the current and voltage.
- 4) Require dedicated and independent VFD for each prime and secondary motor.
- 5) Matching VFD with the motor so that low speed can be achieved.
- 6) VFDs shall have a manual bypass independent of the drive. For motor 37.3 kW (50HP) and larger, provide a reduced voltage starter in the bypass circuit. Motors shall operate at full speed while in the bypass position whenever the speed drive is de-energized and/or open for service.
- 7) VFDs that serve fans shall be able to maintain operation during short power fluctuations.
- 8) Provide 18 Pulse VFD for all motors 56 kW (75 HP) and above and provide 6 or 12 pulse VFDs for all motors less than 56 KW (75 HP).
- 9) VFDs shall have integral passive or active harmonic filters, phase multiplication devices

and any other components required to mitigate voltage total harmonic distortion (THD) to 5%, current THD to 5% at any load level, and no individual harmonic greater than 3% distortion.

- 10) Conduct THD measurements at VFD circuit breaker terminals at full load to show compliance with the above mentioned requirements.
- 11) Locate VFDs in environments that are within manufacturer's specifications. VFD locations shall be as close as practical to the motor to minimize motor circuit conductor length.
- 12) Install incoming power wiring of VFD, wiring from VFD to motor, and motor control wiring in separate, dedicated conduits.
- 13) All VFD associated with supply and exhaust fans serving BSL3 or ABSL3 spaces, which are required to maintain biocontainment, shall be provided with the ability to restart into a coasting motor without delays and without damaging the motor following a power outage and the initiating of the emergency electrical power.

In addition to above mentioned requirements, refer to the DRM, Appendix E.4 "Harmonic Control in Electric Power Systems" for additional information regarding harmonic distortion concerns and refer to the DRM, Appendix E.6 "Selecting and Specify Variable Frequency Drives for HVAC Systems" for additional information regarding variable frequency drives concerns.

A/E shall carefully select VFD to avoid damage to the equipment and preclude introduction of excessive harmonics and noise to the electrical systems.