

# News to Use

## Design Requirements Manual

*The formulae  $\frac{\partial \rho_i}{\partial x} + \frac{\partial}{\partial x}(\rho_i x) - \frac{\partial \rho_i}{\partial x} + \frac{\partial}{\partial x}(\rho_i x) + \rho_i(\rho - \rho_i)$  for building  $\frac{\partial}{\partial x}(\rho_i x) - \frac{\partial \rho_i}{\partial x} + \frac{\partial}{\partial x}(\rho_i x - \rho_i x) + \rho_i(\rho - \rho_i)$  state of the art  $\frac{\partial}{\partial x}(\rho_i x) + \frac{\partial}{\partial x}(\rho_i x - \rho_i x)$  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)

## Power Quality

**P**ower quality is one of the major issue that affects sensitive electronic equipment prevalent in modern research facilities such as NIH. Power quality parameters include voltage sags/swells, momentary interruptions, harmonics, etc. In designing new electrical systems or in major renovations, power quality issues must be addressed to ensure proper operation of all sensitive electronic equipment including research lab equipment, communication equipment, computer, etc.

Use of power electronics in adjustable speed drives improves the operating efficiency but increases electrical system harmonic contents. Likewise, use of non-linear load such as fluorescent lamp, switch mode power supply of computer/printer, and uninterruptible power source (UPS) increases system performance while contributing to harmonic distortions. The NIH Design Requirements Manual (DRM) requires proper selection of equipment to minimize harmonic distortions generated in the electrical system.

The DRM requires that all fluorescent lighting have electronic ballasts that have less than ten percent (10%) total harmonic distortions. In addition, the DRM requires use of 18 pulse variable frequency drives (VFD) for motors rated 75 horsepower and above. For motors rated less than 75 horsepower, provide 6 or 12 pulse VFD with harmonic filters (passive or active), phase multiplication devices, or any other components required to mitigate total harmonic distortion (THD) of voltage to 5% and THD of current to 5% at any load and with both having no individual harmonic distortion greater than 3%.

VFDs that employ shunt tuned filters shall be designed to prevent the importation of outside harmonics which could cause system resonance or filter failure. Provide calculations supporting the

design, including a system harmonic flow analysis, as part of the submittal process for shunt tuned filters.

To effectively address the power quality issues, the DRM also requires that power system analysis be performed to determine if mitigating measures are required when a large number of harmonic generators are anticipated. To mitigate power quality issues, the following steps may be taken i.e. oversizing the transformer serving the harmonic load, specifying k-rated transformer, specifying harmonic filter, oversizing neutral conductors, etc.

The DRM requires that when a large percentage (50% or more) of the load is non-linear, provide the following:

- (1) K-13 rated transformers with 200% neutral wires from transformers to switchboards or panelboards.
- (2) Branch circuit panelboards with 200% neutrals.
- (3) Full-size individual neutrals for each branch circuits.
- (4) Oversized neutrals for shared circuit homeruns for modular furniture.

The DRM requires suppression of transient voltage surges at different levels of the electrical distribution systems to protect the sensitive equipment when a UPS system is not provided as the power source of the sensitive equipment. The protection systems shall include category B3 TVSS protection up to downstream branch circuit level. Furthermore, provide ANSI/IEEE Standard C62.41 compliant Category C3 TVSS protection at the building electrical service entrance when a complete building lightning protection system is required.

To ensure proper operation of the sensitive equipment, specify equipment with low THD output and other mitigating measures as necessary for operation of sensitive equipment.