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News to Use
Design Requirements Manual
The formulae for building state of the art 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'.
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Reliability of Electrical Systems

Reliable electrical power system requires that designers minimize single point of failures in the system. A single point of failure is a single point in the electrical power system beyond which the electrical power system is down from the failed piece of equipment or power supply. Adding redundancies to the electrical power system is usually an effective method to minimize single point failures. This may involve addition of redundant power sources, electrical distribution equipment, cable routing, etc. Ensuring reliable electrical power system for the cutting edge research facilities at the National Institutes of Health (NIH) requires careful consideration of electrical reliability measures, eliminating single point of failures with reasonable cost benefit returns.

In addition to reliability requirements, electrical system at the NIH facilities must be scalable to facilitate future expansions, easy to operate and maintain for the long period of continuous operations since many of the facilities operate twenty four hours a day. As a result, simply adding redundancies or selecting topology without due considerations of all operational requirements may not meet the NIH requirements.

First, designer must consult with all stakeholders to determine the value of uninterrupted operations. This varies from one laboratory to another at the NIH campus depending on the types of research activities conducted in the laboratory. As an example, patient/animal research areas will require highly reliable electrical power systems compared to an administrative building or segment of building with similar functionality. Designers must establish a common ground about the reliability with all of the stakeholders prior to selecting topology of electrical power distribution system and measures to eliminate single point of failures.

Second, designers must establish cost of the various alternate solutions with increasing level of reliabilities so that stakeholders can select an appropriate electrical system that meets the reliability requirements with least negative impact on budget. Reliability calculation for the proposed systems must follow IEEE standard 493 (IEEE Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems). In addition, reliability calculation must include actual historical outage data of Potomac Electric Power Company (PEPCO, the local electric power service provider).

Finally, designers must:

- Choose a network architecture that strikes the right balance between risk mitigation and return on investment (ROI)
- Select reliable equipment configured for each process and load
- Implement an appropriate maintenance policy with corrective, preventive, and predictive measures
- Install a power monitoring and control system with the following features, to help operators make the right decisions and take the appropriate corrective actions:
  - Real-time monitoring of the entire electrical network
  - Alarming, data logging, event tracking, fault analysis, and root cause analysis

Many facilities at the NIH campus have been operating for 30 years or more with continuous need for modification. Therefore, new electrical systems must be scalable as well as compatible with the existing systems to integrate seamlessly with the existing systems. New electrical power system should also meet stringent criteria for reliability including elimination of single point of failures, operability, and maintainability to ensure that designed system will operate for entire life of the building.

Further details on this month's topic are available on the DRM website:
Design Requirements Manual
DRM Chapter 10, Section 3 and Section 9