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Professional Engineering Services
For Mission Critical Industries

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Current designs for mission critical facilities requires much more integration of all the hardened utility systems with the end use equipment than it has in the past. Ultra-high load density computer equipment, hot and cold aisles, dual power cord technology, extended power outage requirements and the need for added flexibility has mandated a revised approach. The design of mission critical facilities must provide the necessary hardening. The computers, broadcast equipment, communications equipment and all other critical equipment should be installed in such a way as to take full advantage of these systems. Where we previously interfaced primarily with the facilities group, we are finding that it is necessary for the end user (IT, Broadcast Engineering, etc.) to be actively involved in the design process. An understanding of the features and constraints of the mission critical design will ensure that the mission critical equipment takes full advantage of the design features of the facility.

RELIABILITY REVIEWS

by Leo P. Soucy, Jr., P.E.

Many of ***FEA***'s projects begin with conducting a "Reliability Review" of a mission critical facility. The first page of the study is a statement of the "Project Business Objective" which outlines, in laymen's terms, what the business requirements are for the facility. It is usually a statement of the business's unique market position, operational requirements and tolerance for failure of the facility.

The "Reliability Review" not only evaluates all the systems supporting the mission critical facility, but ***FEA*** is oftentimes asked to provide "probable cost of construction" for implementing the recommended system upgrades. In meeting with the client during the initial stages of the project, there is a tendency to try to limit the cost of the recommended upgrades that are presented to upper management. It is a natural tendency for the project manager to try to manage this process as they feel that presenting a high cost is irresponsible because they think they know the corporation's financial expectations.

The "Reliability Review" should recommend the most redundant, reliable system which will result in the highest "probable cost of construction". As part of the study, we discuss mission critical design concepts with the expressed intent of educating everyone about the reasons for the recommended upgrades. The client's technical project manager may understand these design concepts, but it is often difficult for upper management to fully understand their meaning and how they can affect the facility especially after only a brief exposure to the design concepts. Upper management understands the financial aspect of the business and can easily relate to the financial aspects of the project. In presenting the cost for the most reliable system, upper management now has a benchmark to evaluate any other proposal. We have presented numerous studies with recommended "probable cost of construction" which exceeded the corporation's expectations. Once these were presented we then discussed the benefits of the proposed upgrades along with other alternatives that would provide some, but not all, of the design concepts that were originally proposed. While these discussions do involve review of the various technical tradeoffs, management has a much better grasp of the fact that they are not getting the best if they know that the proposed design is 80% or 60% of the original proposal.

POWER GRID RELIABILITY

by Brian Soucy

Conventional wisdom concludes that improved control and increased infrastructure investment can ultimately improve the reliability of the power grid and help avoid large-scale outages. However, research has prompted some mathematicians, engineers and physicists to suggest that even the most robust and well controlled power system will inevitably be susceptible to major power outages akin to the Blackout of 2003. In fact, based on historical statistics of actual outages, John Doyle, professor of control and dynamical systems, electrical engineering, and bioengineering at the California Institute of Technology, considers the Blackout of 2003 "overdue."

Why, according to some, are major power outages inevitable? While the specifics of two general theories differ, both are predicated on the fact that the modern power grid is an extremely complex system. The Eastern Interconnection alone consists of thousands of generators and tens of thousands of power lines and transformers. Considering additional variables for human, economic and environmental elements and non-linear relationships between components, current computing technology cannot simulate today's power grid behavior. Research suggests the 2003 Blackout was not simply an anomaly but a characteristic of a complex system "in which the interplay of components leads to surprising outcomes."

This complexity makes it difficult to either predict or understand, not to mention control, the behavior of the power grid. Based on records of small-scale power outages, data suggests that as the magnitude of an outage increases, the frequency of occurrence decreases (fitting a bell shaped curve). However, real life events prove contrary to this statistical model. Prior to the Blackout of 2003, the last cascading outage on the Eastern Interconnection effecting tens of millions of customers occurred in 1965. Based on the magnitudes of these two outages, the frequency of occurrence for the actual events is higher than the statistical model would predict.

So, should we expect a major blackout in the next 40 years? Consider massive earthquakes. No one can predict when the next "big one" will hit; however, seismologists know when one is overdue. Despite disagreements on the root cause of an inherent vulnerability, the idea that major outages are an undeniable characteristic of the power grid has gained acceptance in academic circles.

To the dismay of grid operators, utility engineers and politicians, a team at Carnegie Mellon University argues that if blackouts are as difficult to predict and prevent as earthquakes, the question is not how to prevent blackouts, but how to survive them.

Survival may be the only option for facility managers and owners. At least within the confines of their building, owners have control of their power's reliability and have been prudently exercising this control for years with dual services, back-up generation and uninterruptible power systems. However, the notion that a large regional blackout, like the one of 2003, will occur more frequently than once expected may mean paying closer attention to some site-hardening details.

For example, current on-site fuel oil storage capacity may be sufficient to ride through localized outages but not prolonged outages accompanying a regional blackout. Increasing storage capacity, load shedding or both may help extend the runtime of standby generation.

A regional blackout may affect a primary site and an intended disaster recovery location if located on the same interconnection. Distance alone may not be the answer if two facilities are fed from a common regional power grid. Locating a site outside the regional power grid or identifying several optional sites may help reduce the risk.

While academics and members of the utility industry may debate the risk, frequency and prevention of a regional blackout, the reality is they can and do occur. The best defense for facility owners is to plan and prepare for survival.

Information for this article was obtained from the article "The Unruly Power Grid" by Peter Fairley in the August 2004 edition of IEEE Spectrum. (http://www.spectrum.ieee.org/WEBONLY/publicfeature/aug04/0804grid.html)

7x24 Design Concepts

by William H. Flaherty, Jr., P.E.

A comprehensive design for a 7x24 facility must employ design concepts that are much more stringent than those used on standard industrial or office projects. If these concepts are not included, the design will not provide the performance required during fault conditions.

The first step in determining what concepts should be included is to determine the level of redundancy required by the client. A client/engineer interview will provide a format for reviewing the various alternatives available. Once the level of redundancy has been determined, the engineer can proceed with a design that includes not only the 7x24 aspects of the project but also other factors such as type of electrical/mechanical equipment, emergency power generation and adequate fire protection.

The 7x24 design should include solutions that will provide for the redundancy requirements of the client.

<u>Mechanical issues:</u>

- ⇨ Consideration of alternate equipment technologies.
- ⇨ Securing adequate space for equipment and maintenance access.
- ⇨ Cooling equipment capacity
- ⇨ Heat rejection technology and capacity.
- ⇨ Multiple utility resources.
- ⇨ Piping and valving networks that will allow changes and/or maintenance without shutting the system down.
- ⇨ Airflow distribution that will provide proper cooling to the expected loads.
- ⇨ Generator fuel delivery and storage systems

<u>Electrical issues:</u>

- ⇨ Consideration of alternate equipment technologies.
- ⇨ Securing adequate space for equipment and maintenance access.
- ⇨ Power distribution into the site
- ⇨ UPS and battery design
- ⇨ Generator capacity
- ⇨ Paralleling and utility/generator power transfer
- ⇨ Distribution of power to the critical loads
- ⇨ Powering of electrical and mechanical equipment

<u>Other areas which impact 7x24 design:</u>

- ⇨ Building automation systems that address proper logic, redundancy, monitoring and alarms.
- ⇨ Fire protection and alarm technologies that can provide protection from catastrophic events while also protecting the technology being supported by the 7x24 system.

The above items are only some of the many issues that must be considered if a 7x24 design is to be successful. An engineering firm that is well versed in the field and that has a resume of successful projects is the best way to assure that the proper concepts will be considered and incorporated into a project.

Interesting Facts

Hospital Data Centers

Electronically controlled equipment has been used extensively in the care of patients but this equipment has primarily been individual, standalone devices. Hospitals are increasingly consolidating all patient information in computers located in centralized data centers. Not only is all of the patient information stored in the computer, but hospitals are progressing towards paperless environments where wireless, handheld terminals will be used to access all patient information including patient status, historical information, medications, any medication interactions, and real time monitoring of patient vital statistics. The computers will also control the individual patient monitoring equipment and notify the staff if there are any problems.

As computers continue to be deployed in the direct monitoring and care of hospital patients, these data centers are now considered mission critical facilities and require extensive upgrade to meet these new challenges.

Policy

designPLUS Newsletter is published to keep the readers current with the latest trends in mission critical systems.

Correspondence

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