in this ISSUE:

- Mission Critical Design Considerations
- Project Organization Strategies
- Considerations for Battery Selection and Monitoring

design PLUS

FEA

facilities engineering associates
128 Garden Street, Farmington, CT 06032

Professional Engineering Services
For Mission Critical Industries

designPLUS

Winter 2004

In the Fall 2003 designPLUS Newsletter, we conducted a survey which was very successful. We received many suggestions for future articles and the overall response to the newsletter was positive. If you have suggestions for future articles, you can submit them on our web site www.FEACE.COM. Go to the 'Newsletter' page and click 'SUBSCRIBE'.

To date, we have assembled over thirty articles on different mission critical subjects. It is our intent to include articles providing an overview of the industry as well as more technical articles concentrating on specific design issues. We hope you have found them informative and entertaining. If you would like to review any of the articles, you can see them on our web site on the 'Newsletter' page.

Along with the publication of the quarterly newsletter, we update the designPLUS Newsletter Index which provides a quick way of locating previous articles on a specific topic. The index is on our web site at www.feace.com/downloads/Index.PDF.

Mission Critical Design Considerations

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

Recently, ***FEA*** has been involved in the investigation of failures at numerous mission critical data centers. These have included an analysis to determine the root cause of the failure and also a Reliability Analysis to determine to what extent the systems need to be hardened to meet the present "Business Objective" of the client.

It quickly became evident that during the design of the data center there was not sufficient emphasis placed on the mission critical design requirements. *The facilities failed to provide the needed reliability because they were not properly designed*. This was either because the Owner did not adequately inform the design team of the importance of the facility, the mission of the facility changed, the design team did not realize the importance of the facility to the business and did not ask the pertinent questions, or the design team did not understand how to design a hardened mission critical facility. The Owners did not realize that their facilities were not hardened and were surprised when the outages occurred, but unfortunately the Owner's business operations were still seriously affected by the outage. In conducting the analysis it was found that the IT departments had provided hardened equipment (dual power cord servers, redundant hardware, hardened software, etc.) and assumed they were adequately protected, but had not taken into consideration the hardening of all the supporting utility services.

It is important to remember that the design of a data center that is critical to a business needs specialized design expertise.

With the increased computing power available in small servers, mission critical corporate data centers are now being constructed in corporate office buildings without the necessary emphasis placed on the mission critical design aspects required of the supporting facilities. ***FEA*** is now being commissioned to redesign these systems with the upgrades costing much more than if initially designed properly. In some cases it is not possible to implement the upgrade without a shutdown of the data center.

One approach to this problem is to have a specialized team design the mission critical facility with the building team designing the standard spaces. ***FEA*** has worked on many projects in this capacity where the building was designed by one design team with ***FEA*** performing the design for the mission critical facility and its associated support facilities. This has worked very well with very favorable response from the Owner and building design team. In this arrangement the Owner receives the specialized design services required for the mission critical facility, with the building design team relieved of this specialized design service which many times they do not fully comprehend.

Project Organization Strategies

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

High reliability projects can become very complicated and attention to detail is paramount. Details that are neglected or ignored during the design process or construction administration phase of a project can turn into serious problems if they are not adequately addressed at the appropriate time. Good communication between all project participants is essential if a project is to be successful. We have developed two documents which have fostered excellent communication. They aid in keeping track of the design decisions and open items.

Design Decisions Log

The Design Decisions Log is a document which chronicles decisions made by the design team and the client. Each decision is dated and described in enough detail so that later review will allow the design engineer to include or exclude certain design elements into the final design of the project. The client also reviews the document to insure that the design elements are providing or not providing the features required by the business objective. This document provides a concise depository of critical decisions during the design cycle and aids in precisely defining the project goals. Design parameters such as electrical and HVAC loads are specifically defined and noted on this document.

Open Items List

An Open Items List is a document which is used to keep track of tasks that need to be addressed. These tasks can be assigned to any participant in the project and ranked in order of importance. It serves as a short form of meeting minutes and aids in tracking the progress of tasks which may take several weeks or months to implement. Dates, contacts and project progress are documented. When items are completed, they are moved to the completed section of the list for easy reference, if needed.

We have found that the use of the above documents has brought focus to decisions and served to communicate design intent and task progress to both the design team and clients. The use of these documents is not limited to large projects. We have found them useful on any size project whether it is a new design or a redesign of an existing facility.

The Open Items List provides an excellent method for performing a reliability assessment of a facility and help in tracking the implementation of the identified upgrades. ***FEA*** is presently using the Open Items List on three projects for review and upgrade of mission critical facilities.

Considerations for Battery Selection and Monitoring

by Rafiq G. Bulsara, P.E.

Batteries are the most important elements in an Uninterruptible Power Supply (UPS) system. However, they are also the weakest link because of their propensity to fail, often without warning. Factors other than reliability and performance often influence the selection of a battery for a particular system. Other factors are cost, floor space, environmental considerations, maintenance, etc. The following is a brief discussion of the merits of 'flooded' or wet cell batteries using lead acid versus dry type or VRLA (Valve Regulated Lead Acid) batteries.

Wet cell batteries have been in use for more than a century and have proven to be very reliable although many perceive them as expensive. Wet cell batteries can provide large capacities and very good service life for up to 20 years. Users of large UPS systems and large telecom systems have historically relied on wet cell batteries. That trend does not appear to be shifting. Small and medium sized telecommunication applications are using more VRLA batteries, as it suits their application. This does not automatically make VRLA batteries suitable for UPS applications. The proliferation of small UPS systems used by small information technology related businesses has prompted the use of VRLA batteries. These small installations tend to shy away from using wet cell batteries due to the perceived maintenance, floor space constraints, environmental issues and to some extent lack of complete information related to the battery characteristics. In performance, wet cell batteries typically outperform VRLA batteries simply because they have a larger volume of acid available. Wet cell batteries are especially superior in applications requiring large current for a short period of time (a few minutes), a typical requirement for UPS systems. The VRLA batteries become comparable in performance to wet cell batteries in applications requiring low current for longer periods of time. This is a typical need

for the telecommunication industry. The key difference is in the expected service life. VRLA batteries typically last 5-7 years and, in many cases, have failed within 3-4 years of installation for a variety of reasons. Many users are attracted by a common misnomer, "maintenance-free", for VRLA batteries. This is not true, but VRLA batteries do require less maintenance than wet cell batteries. Wet cell batteries require replenishment of water on a regular basis. Also, wet cell batteries require detection and ventilation of hydrogen and acid spill containment and more floor space.

It should be noted that there have been marked advancements recently in the technology for the VRLA batteries. Positive grid corrosion is a leading cause of VRLA battery failure. Thicker and less porous plates provide longer battery life. Self discharge of the negative plates, another cause of VRLA battery failure, is countered with the use of a catalyst to help recombine the oxygen and hydrogen to recover the water lost from electrolysis.

Battery Monitoring

Close monitoring of the health of the batteries is critical in maximizing the service life of a given installation by quickly finding any impending failures and rectifying them before they become catastrophic. The cost of battery monitoring systems are not dependent on the rating of the battery but the number of cells monitored. In a UPS system, the number of cells may be the same regardless of kW size. This could explain why many VRLA battery users do not get advanced warning of a battery failure.

A variety of battery monitors are on the market. Not all of them supply all the necessary features and the battery manufacturers do not require all of these features to warranty their products. In fact, many battery manufacturers recommend a monitor which only counts charge and discharge cycles. Normally this does not help predict any imminent failure but only gathers data which could be used against fulfilling a warranty! We feel that the art of battery monitoring is not yet perfected, but a general consensus is that the most important parameter to monitor is the internal resistance of each cell to determine the health of a battery. More than a 25% increase above the base line value of internal resistance is considered to be a bad cell. That is, it will not deliver more than 80% of its capacity. The base line value would be the internal resistance of a known good and fully charged cell. From a warranty point of view, most manufacturers will say 40%-50% increase in internal resistance should be used as a value to determine the end of useful life of a battery cell. Also, only 'dc' resistance measurement is useful. An instrument measuring 'ac' resistance will give erroneous results, especially on larger size batteries. Besides the internal resistance, other monitored parameters are usually cell voltages, ac ripple currents and discharge/charge cycles.

Testing

Finally, there is no substitute for a full capacity (load discharge) test to determine the health of a battery system. It is often deferred by users for a variety of reasons including lack of confidence in the system or just not wanting to take any chances. IEEE standards recommend at least five capacity tests during the service life of a battery system.

Mission Critical Design

The design of mission critical facilities requires applying specialized design concepts to the following systems:

- Building construction
- Geographical & site considerations
- Incoming electrical power
- Standby generation
- Standby generator paralleling switchgear
- Power distribution systems
- UPS systems
- UPS power distribution systems
- Critical air conditioning systems
- Central chiller plants
- Pumping systems
- Chilled and condenser water piping systems
- Diesel fuel systems including redundant pumping & fuel storage
- Liquid detection systems
- Emergency power off systems
- Fire alarm systems
- Fire suppression systems
- Security
- CCTV
- Code and signal reference grounding systems
- Fire separation
- Site monitoring system
- Supervisory Control And Data Acquisition (SCADA) Systems

Policy

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

Correspondence

FEA welcomes any letters, articles, reports and comments for publication. Please mail, fax or email written material to:

Facilities Engineering Associates
128 Garden Street
Farmington, CT 06032
Tel. 860-677-2285
Fax. 860-676-9433
Email LSOUCY@FEACE.COM
WWW.FEACE.COM