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design PLUS

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Professional Engineering Services
For Mission Critical Industries

designPLUS

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Facilities Engineering Associates is committed to the design of mission critical facilities in the financial, industrial, credit processing and broadcast industries.

As part of our mission, we realize that it is necessary to inform and educate our clients in the specialized mission critical design philosophies of redundancy; capacity; 7x24xForever and fault tolerance. To this end we publish the quarterly designPLUS Newsletter to keep our clients current on trends in the mission critical industry. We also meet with clients and present the various design philosophies to assist them in making informed decisions regarding hardening their mission critical facilities.

As a design firm, we constantly strive to provide solutions that meet our clients' business objectives. Having an informed client is paramount to meeting this goal.

We hope you find this issue interesting and informative, and we encourage you to email us with suggestions for topics that you would be interested in seeing in the future.

NEW YEAR'S RESOLUTION

By Leo P. Soucy, Jr., P.E.

2005 was a very significant year with regard to natural disasters and, while they may not have affected us directly, we were all moved by the graphical depiction of the personal suffering and physical destruction. Whereas these were major regional events, there are many more smaller, natural and physical events that have affected many of our clients.

With the beginning of the new year we often make New Year's resolutions by developing positive steps for improvement. It is also the time of year where we look back over the past year to review the good and bad that occurred and often use these events to shape our New Year's resolutions.

You may find it beneficial to review some of the events that occurred last year that adversely affected your business, which were surprises or events that caused more inconvenience than anticipated. When you conduct this review it is important to take a fresh look at your business and what is essential to its ongoing operations. Here are some of the questions that may be helpful in determining areas for improvement:

- Has the business environment changed requiring mission critical hardening of additional departments and services? Example - departmental function change requiring that the telecommunication system and all workstations be provided with uninterruptible power.
- Do the existing mission critical systems provide sufficient protection to meet the business requirements? Example - business function changed to where an N+1 generator system is required in lieu of the present single unit.
- Are there support systems that are not hardened that can affect larger systems? Example - a single fuel pumping system providing fuel to the entire emergency generator plant.
- Have backup systems been fully tested to ensure operation if the primary unit fails? Example - generator plant fails during an outage due to not properly starting, faulty fuel, overheating, etc.
- Are redundant systems properly configured from their source to the load? Example - redundant air conditioning fed from a common power panel whose failure will shut down all cooling.
- Is preventative maintenance being performed as necessary?
- Is all the critical support staff fully trained in the off-normal operation of the facility?

I hope this helps in developing your New Year's resolutions that will improve your mission critical facilities so there are no surprises in 2006.

STSs AND DUAL CORD EQUIPMENT

by John M. Lane, P.E.

Three-phase static transfer switches (STSs) became available in the mid 1990's to transfer between two power sources. Back then, critical loads primarily consisted of single cord computer equipment. STSs became very popular to support them with two power sources. Now, dual cord equipment forms the majority of the computer equipment in a data center. Some users are now considering eliminating STSs in the distribution scheme and relying on the dual cord power supplies to maintain power to critical equipment in case of a failure of one of the power sources. This is primarily due to the increase in reliability of the dual cord equipment to maintain continuity of power and adverse experiences with the STSs themselves. This approach requires the consent of the IT group and close coordination and understanding between the facilities group and the IT group. STSs or some kind of fast-acting transfer switch is still required to support single cord equipment from two power sources.

Cost and reliability of the STSs are among the factors influencing the final decision Some users see STSs as single points of failure by themselves. Some see them as being redundant when dual cord equipment is being served. It is true that STSs are sophisticated and complex pieces of equipment. There are a lot of electronics in the switch that enable sub-cycle transfers. This level of technology comes at a price, typically $40k-$60k per switch, installed. And although the STS designs are proven, they are not perfect. Some users have experienced maintenance issues, including false alarms and faulty ancillary functions such as metering and monitoring control boards. Although STSs very rarely drop load, persistent service calls do not inspire confidence.

On the other hand, STSs do provide a convenient way of taking a UPS offline for maintenance without affecting the load. Therefore, if the STSs are eliminated, a manual closed-transition-transfer arrangement should be installed between the two UPS buses so that a UPS system can be taken offline for maintenance without interrupting power to critical loads. When installing dual cord equipment, it is imperative that one cord be plugged into Bus A and the other into Bus B. Also, the IT group has to confirm with each equipment vendor that power supplies in dual cord equipment are intended for redundancy and not for capacity. Single cord critical loads still require some type of STS to facilitate the emergency transfers between the A and B buses.

A non-STS, dual cord type distribution concept, is not without risk. In an STS distribution system, switching occurs at the STS and both computer power supplies remain powered. In a non-STS dual cord system, loss of one of the sources results in a loss of power to one of the computer power supplies. It is important to note that no actual switching occurs between the two power supplies. Both power supplies are normally energized sharing the load and, upon one failing, the other simply assumes the total equipment load.

If one of the computer power supplies has failed and the alternate source fails, the equipment will lose power if no STS is used. An STS will protect load even if one of the power supplies has failed. Some computer equipment is available that monitors its own power supplies and exports this information to a remote central system. This risk can be mitigated if you know that a power supply has failed before you commit to one source of power. It is imperative that equipment be selected not only by function and cost, but by its ability (reliability) to repeatedly switch sources. Since the reliability of a non-STS dual cord distribution system relies predominantly on dual cord equipment in an emergency, the selection of this type of system should be made with input from the people who select the computer equipment.

Some equipment is provided with more than two power supplies or cords, mostly arranged so that they can sustain failure of only one of them. Therefore it is important that one of the cords of a three-cord or a four-cord system is on an STS or a rack mounted fast transfer switch.

Considerations for not using STSs in the Data Center Distribution System are:

<u>Pros</u>

- ⇨ Reduction in initial costs (typically $40-$60k installed per switch)
- ⇨ Reclaim floor space (typically 12 - 24 sq ft per STS)
- ⇨ Simplify the distribution system
- ⇨ Eliminate the maintenance associated with STSs

<u>Cons</u>

- ⇨ Wire management: It is imperative that one cord of the dual cords be plugged into Bus A and the other into Bus B.
- ⇨ If one of power supplies has failed and the alternate source fails, the equipment will lose power if no STS is used.
- ⇨ Must confirm with each equipment vendor that dual cord equipment power supplies are intended for redundancy and not capacity.
- ⇨ In an emergency, the system is only as reliable as the critical equipment installed.

7 X 24 PROJECT TESTING AND MAINTENANCE

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

7 x 24 projects require a great deal of specialized engineering design and careful attention to detail. When the design is finished, there is much additional work to do to be sure that the design is built in accordance with the drawings and specifications and that all the parts and systems are installed correctly during the construction phase. Extensive construction administration during all phases of construction provides assurance that the systems are installed as designed. The major systems such as uninterruptible power supplies (UPS), static transfer switches (STS), generators, and chillers should be verified for proper operation and capacity at the factory before shipment. Factory witness testing provides the knowledge that the systems are built correctly and, if field issues arise, there is a good probability that the field connections or interactions between pieces of equipment are causing the problem. Troubleshooting problems can be focused on these interconnections rather than the equipment itself.

When the project becomes operational, the integration testing phase provides documented proof that the installed systems meet the intended design goals in terms of capacity, redundancy and performance. Testing subsystems at the factory or in the field assures that the major components perform as intended, but is no substitute for testing the total integrated system.

FEA believes that the integration tests are best specified and performed by the design engineer who has intimate knowledge of the intricacies of the equipment and design goals. The test procedures must outline the features to be tested, participants, test equipment required and any conditions necessary to conduct a proper test including safety issues. Each test procedure must be a step-by-step procedure with each step of the test initialed and dated. This ensures not only that each item is completed, but also establishes a time line when the test was conducted.

Having the facility staff involved at the very beginning of testing allows them to become acquainted with the equipment and the inter-relationship of each component. Their input as to how or what to test can sometimes result in the discovery of flaws that can be corrected before the systems go on line. Staff involvement during the testing phase can also provide a comfort level with the new equipment without the stress of learning new procedures and becoming familiar with equipment that is on line and making mistakes that could cause an outage.

Properly designed and documented tests also provide a benchmark that can be used by the owner to compare against future performance to judge if systems are loosing their robustness. As systems age, their capacity may start to decay and their current performance can be compared to the original documented capacities to judge if additional maintenance or replacement of components is indicated.

There is no question that mission critical systems will be tested at some time. It will either occur in a controlled environment during integration testing and before the system goes on line, or be imposed on the system due to uncontrollable environmental events or equipment failures after the system is on line. ***FEA*** believes that it is best to perform all testing in a controlled environment during integration testing before the systems go on line.

FOOD FOR THOUGHT - WATTS PER SQUARE FOOT *AGAIN*

FEA has recently designed air conditioning systems for projects with load densities of 50 to 400 watts per square foot. What we are finding is that air conditioning systems need to be designed to accommodate very specific load densities. Average w/sf designs are no longer appropriate for serving high-density loads. Much closer coordination between the air conditioning engineer and the information technology hardware planners is required for high-density 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:

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