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Professional Engineering Services
For Mission Critical Industries

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Facilities Engineering Associates has been involved in the design of mission critical data centers for the past 16 years. We are finding that these design techniques have universal appeal to any industry that is concerned with 7x24xForever availability.

Recently, we provided our engineering expertise in the design of digital broadcast facilities. As the broadcast industry converts from analog to digital technology, they are facing the same problems data centers have been encountering for many years since the new media relies heavily on computers and digital transmission.

As companies become more dependent on 7x24xForever operability, expansion to international markets and e-commerce, mission critical system designs will become a necessity.

Disaster Avoidance

*by William H. Flaherty, Jr., P.E. - **FEA***

Almost every conversation concerning 7x24 facilities eventually touches on the topic of Disaster Recovery. Many organizations have a specific individual designated as the Disaster Recovery Manager whose job is to prepare a plan which will streamline the recovery process if or when a major disaster occurs. We believe that more planning and thought should be given to being proactive rather than reactive when a situation occurs. Certainly there are occurrences that make disaster recovery plans necessary such as the aftermath of the 9/11 disaster or a major weather anomaly which causes structural damage or flooding of the facility. These events are rare but must be planned for. However, there are many more subtle occurrences which can cause outages that have a significant financial or operational impact on the mission of the organization.

Thought should be given to changing the title of the Disaster Recovery Manager to Disaster Avoidance Manager. This person would not only be reactive to events but also be proactive to foresee potential problems before they occur. A Disaster Avoidance Manager would be responsible for the overall system design and overseeing the reliability aspects of all facets of the facility. Careful consideration of the ramifications of deferred maintenance and the risks associated with maintenance windows being made available during peak operational periods are critical decisions that could result in disaster avoidance. The Disaster Avoidance Manager should review facility modifications or new designs as to their 7x24 suitability. This would aid in helping to prevent outages rather than reacting to them after the fact which could require implementation of the disaster recovery plan.

Don't Forget Mechanical Hardening

*by Marc Soucy - **FEA***

In today's society of 7x24 operation, many companies are creating what are called Mission Critical Facilities. The first thing that comes to most people's minds when talking about a Mission Critical Facility is Power. Uninterruptible power for the facility is what everyone is trying to provide and where most people are willing to invest hundreds of thousands of dollars. It is true that reliable power is the most important element to any Mission Critical Facility; however, there are a host of other key elements to the mission critical system which, if neglected, could very quickly shut down any facility. These other key elements being mechanical in nature are often overlooked, viewed as not as important, or not worth the extra money to harden. On the contrary, it is these systems that allow the UPSs, Generators, and other equipment to operate properly and be more reliable.

As a server or UPS operates throughout the day, it generates a great deal of heat. If there is an inadequate or unreliable mechanical system supplying cool air to the server or UPS room to remove this heat, the equipment will eventually overheat and shut down. An inadequate or unreliable cooling system can be caused by many different things. Some of the obvious situations are not having enough redundant cooling units, pumps or chiller capacity; or not being capable of performing maintenance, upgrades, and/or surviving an individual unit failure. Less apparent situations could be having an unhardened cooling tower make-up water system or building management system. These shortcomings can go unrecognized for many years but are truly the weakest link and have a great failure potential in an otherwise hardened system.

There are a number of other situations where the mechanical systems aid in the operation of electrical equipment. One example would be the processing and distribution of fuel oil to the generator. As fuel oil sits idle in a tank, various bacteria will begin to grow. If this bacteria or sludge were to reach the generator fuel injectors, they could become fouled over time and cause the generator to fail. Installing a reliable fuel filtering and distribution system would greatly reduce the possibility of "dirty" fuel reaching the generators and in turn increase the reliability of the whole emergency power system.

A lot of focus is directed towards the electrical equipment in a system because it is the first line of defense against a power failure. A quick evaluation of a facilities electrical system could give the illusion that it is a very hardened system. However, when evaluating a Mission Critical Facility, one must look at the whole picture. Saying a facility has multiple redundant UPS units with multiple redundant emergency generators sounds pretty good. However, if the one pump supplying fuel oil to the generator daytank fails or the pump alternator on a dual pump system fails during a power outage, the multiple redundant generator installation will become useless.

The previous examples demonstrate some possible failures to a system that could result in a substantial amount of downtime. One thing to remember is that downtime is not only described as a loss of power due to unplanned equipment or power failures. It could also be a loss of power by shutting equipment down to tie in new equipment or perform maintenance. A good 7x24 design takes all this into consideration and provides the owner with such things as redundant piping and equipment to eliminate any single point of failure and the need for maintenance windows. This will give the owner the ability to isolate parts of the system, both electrically and mechanically, without shutting the system down.

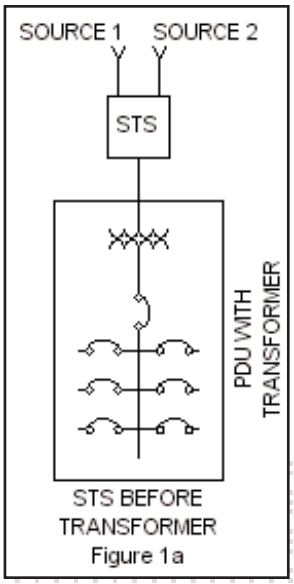
In the world of Mission Critical Facilities, the main goal of all business owners is to reduce the probability of any type of downtime. Whether downtime comes as a planned or unplanned event, having a true 7x24 electrical and mechanical design gives you the confidence that the system can handle any type of failure yet is flexible enough to meet your future needs.

STS: Before or After PDU Transformers?

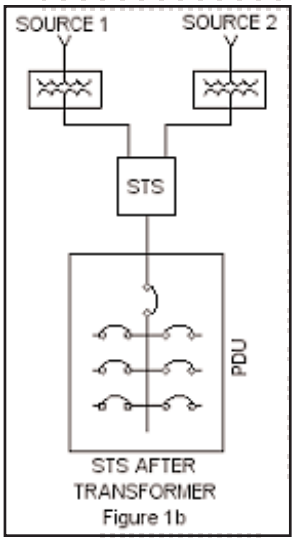
by Rafiq G. Bulsara, P.E. - FEA

It is often debated whether the Static Transfer Switches (STSs) should be installed before or after the Power Distribution Unit (PDU) transformers in a data center application.

More commonly, they are applied before or on the primary side of the transformers (Figure 1a). A system with STSs on the primary side of the transformers is less expensive as it uses a single transformer per PDU. The STS rating and physical size is smaller, it requires less wiring and occupies less floor space. A system with STSs on the secondary side of the transformer (Figure 1b) is more expensive. It uses two transformers per PDU, larger STSs, approximately double the amount of wiring, and occupies more floor space. While dual transformers may appear to be offering redundancy, a single transformer is generally regarded as a very reliable piece of equipment. Many users do not see dual transformers as a great advantage.



STS BEFORE TRANSFORMER
Figure 1a



STS AFTER TRANSFORMER
Figure 1b

A primary side STS system looks more attractive if the majority of the load is dual power cord equipment fed by a pair of PDUs, which in turn are fed by two STSs. A dual power cord installation with secondary side STSs becomes much more complex, large and prohibitively expensive.

A key technical advantage of the STSs on the secondary side of a transformer is that there is no transformer inrush current or core saturation when making out-of-phase transfers between two sources. This also helps minimize stress and maintains the stability of the upstream UPS system. This could be a key consideration when there are a number of PDU transformers, and the user has decided to permit out-of-phase transfers during emergency conditions.

At least one STS manufacturer is offering an optional 9 to 12 ms delay between transfers to minimize the transformer inrush when the phase angle difference between the two sources is between 90 and 180 degrees.

As you can see, there is no definitive answer to *STS: Before or After PDU Transformers.* However, it needs to be reviewed by a knowledgeable and experienced engineer and the best solution selected to meet the Owner's needs.

Food For Thought

Reliability is expressed by the number of 9s that are achieved with a particular design.

A 5 - 9s design can be expected to be off-line due to an equipment or system failure for 5.3 minutes per year.

We have found that achieving system reliability above 3 - 9s requires not only proper system design but proactive maintenance, extensive training and detailed operator switching/valving procedures.

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