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Professional Engineering Services
For Mission Critical Industries

design PLUS

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When we design mission critical facilities, we strive to meet specific reliability criteria. These can be stated as 99.9% or 99.99% reliable, which can then be equated to the amount of downtime per year. A better matrix is the "Probability of Failure" over a 20-year facility life, which at these stated reliability factors is 100%.

It is interesting to look at these numbers in the real world as we seldom have an actual situation to cite. We recently had an N+1 facility with a reliability of 99.749% have a UPS and generator failure. At the stated reliability, the facility has a 20-year probability of failure of 100%. The data center UPS was upgraded in the early 1990's with the generators installed in 2000. Recently, the UPS and generators failed resulting in a complete shutdown of the data center.

Unfortunately the system operated as predicted. It is important that the Owner perform a comprehensive risk assessment so that they are aware of the financial implications of a particular design.

Preparing a Project Business Objective

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

Many clients are unsure of exactly what they want or need in a 7x24 data center. Some clients have an existing data center that may need updating while others are in need of a brand new facility. Many of our clients have found it very helpful to commission a study before actually requesting any engineering services. A study can help them plan for future updates or expansions as well as look at estimates of probable cost for budgeting purposes.

The first step in commissioning a study should be to prepare a Project Business Objective. A Project Business Objective is a written statement prepared by the client which states what the client expects from the present or future facility and how it will affect his mission. This statement provides a criteria or a mission statement to which an evaluation can be compared when reviewing a facility. In the case of a new facility, design goals will be reflected by the contents of the Project Business Objective. ***FEA*** can aid clients with the preparation of the Project Business Objective but only the client can determine what the requirements will be.

Items to be considered but not limited to are:

1. Brief description of the mission of the facility.
2. What is the goal of the project?
   a. Determination of facility potential
   b. Increased capacity
   c. Better reliability
   d. Redundancy
   e. Replacement of aging systems
   f. Security
   g. Ability to withstand natural disasters
   h. Global business concerns
3. 7 x 24 x ???
   a. Does the facility really need to be 7 x 24 x ???
   b. Is a reasonable risk vs. cost environment good enough?
4. Uptime required
   a. Can shutdowns be taken either planned or unplanned?
   b. Can maintenance and/or upgrades be performed during a shutdown?
5. Is state-of-the-art technology required?
   a. Does the facility need to be on par with leaders in the industry?
   b. Is the facility considered to be World Class?

As can be seen by the above questions, the client must thoroughly evaluate what his needs and desires are. Once the direction is known, a study can be commissioned to look at various options and provide possible solutions to issues raised in the Project Business Objective. When options are known, probable costs can be prepared to aid in budgeting and evaluating suggested design options.

Data Center Reliability Issues

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

Since 9/11 and the August 14, 2003 Northeast Blackout, there have been significant changes in the manner in which corporations view disasters. This concern is not only over natural disasters but also corporate internal governance issues due to numerous corporate financial scandals.

Since 9/11 and the August 14, 2003 Northeast Blackout, the Securities and Exchange Commission (SEC) has published a number of white papers outlining requirements for financial institutions to allow them to survive these types of events. At the present time these are only recommendations issued for comment but it does provide an insight into the SEC's thinking regarding disaster mitigation. One of the recommendations is to not only harden critical assets but also to have fully functional "disaster recovery" sites remote from the main facility.

With regard to corporate internal governance issues, we are all well aware of Sarbanes-Oxley and the implications it has had on all corporations.

While Sarbanes-Oxley is mainly concerned with holding corporate executives accountable for financial matters, compliance involves detailed audits that delve deeply into the corporation including the IT organization.[1]

In addition to the above issues, there is a growing concern by corporate officers regarding stockholder lawsuits for not performing in their best interests. This has heightened the awareness for hardening critical corporate functions. Corporate officers are becoming sensitive to the requirement of implementing "best practices" throughout the corporation, knowing full well that their corporation and possibly they can be held personally liable if a disaster occurs and they have not taken appropriate measures to avoid or at least reduce any losses.

Based on these concerns, ***FEA*** has assisted a number of SEC regulated financial centers to harden their data centers and implement disaster recovery plans. We have also performed numerous "Reliability Reviews" for non-SEC regulated financial institutions. These have mainly been implemented due to concerns about liability issues from stockholders.

Industry Standard Tier Classifications

The Uptime Institute is an organization dedicated to assisting mission critical facilities in reviewing their systems with regard to mission critical hardening and distributing information regarding these issues.

Corporations make decisions based on financial and risk assessments. With that in mind, The Uptime Institute has developed a matrix outlining the availability of a data center based on the level of hardening of the infrastructure. They have developed a four tier design criteria for mission critical facilities.[2]

Tier I systems are N+0 providing a site availability of 99.671% resulting in a potential 28.8 hours of annual IT downtime. This downtime may be attributable to equipment failure, but it is also necessary to shut down the equipment to perform annual maintenance. It is important to note that the potential downtime may not occur annually, but over a period of time it will average out. For example, when preventative maintenance is not performed on a Tier I facility due to the fact that it requires a shutdown, at some point there will be a major equipment failure that can shut down the facility for hours or even days.

"Best practice" design results in a Tier IV facility which has a site availability of 99.995% resulting in a potential 24 minutes of annual downtime due to the site infrastructure. This hardened design improves the reliability of the facility by a factor 72.

Power Grid Reliability

Over the past ten years there have been large scale power outages in California, western and northeastern United States and Europe. Conventional wisdom concludes that improved controls and increased infrastructure investment can ultimately improve the reliability of these power grids and help avoid large-scale outages. This has been studied extensively since the August 14, 2003, northeast power outage and the findings indicate that it may not be possible to improve the power grid reliability because the systems are so large and complicated. The outages that occurred were overdue and could be repeated at any time.[3]

Conclusion

All these factors indicate that outages and equipment failures will occur, and only present "best practice" designs can substantially reduce their occurrence and impact on the mission critical function.

Only the corporation can assess the risks associated with not implementing the "best practice" design for their mission critical facilities, but not implementing an upgrade that will result in a 72 times improvement in reliability is hard to defend.

References and additional information can be found at the following web addresses:

1 - Information on the impact of the Sarbanes-Oxley on information technology http://www.dmreview.com /article_sub.cfm?articleId=1014514

2 - Information on the Uptime Institute's Standard Tier Classi fication http://www.upsite.com/ TUIpages/whitepapers/tuitiers.html

3 - Information derived from a designPLUS article by Brian Soucy, in the Winter 2005 issue, which was based on "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.

Hot & Cold Aisle Coordination Issues

By Marc Soucy

Many of today's data centers are now making the transition from a traditional cooling configuration (i.e cooling the entire space with air evenly distributed from a raised floor) to a hot and cold aisle arrangement as their loads and rack densities increase. This allows for a more efficient use of the supply air, as the air is distributed directly to the heat sources. Designing an air conditioning system for a hot and cold aisle arrangement in an active data center requires a coordinated effort between the consulting engineers, facility managers, contractors and the IT department. Each group needs to have a good understanding of what hot and cold aisles are and how they operate. The design process starts with input from the IT department as to how they want their racks to be arranged and where the high loads are located. This information is then used by the engineering firm to lay out the cooling system to accommodate the hot and cold aisle configuration. The actual arranging of the IT racks into hot and cold aisles needs to happen in conjunction with the air conditioning installation. In a traditional data center setup, the racks are positioned throughout the data center floor with little thought as to the location of the rack air intake. This traditional setup requires cooling the entire room.

With a hot and cold aisle arrangement, the racks are set up so that they draw in cool air only from a cold aisle and exhaust hot air only into a common hot aisle. The cold air distribution system must also be designed and installed to accommodate this arrangement.

The timing of the air conditioning system installation and rearranging the racks into hot and cold aisles is also very critical. If the cold air distribution system is installed for a hot and cold aisle configuration but the racks are not arranged accordingly, numerous hotspots and potential equipment failures will be experienced throughout the data center. If the timing of the two cannot be coordinated to happen simultaneously, temporary cooling must be provided in the interim.

Another very important aspect of a successful hot and cold aisle configuration is the proper and complete installation of the air conditioning equipment and distribution system. Much thought goes into the layout of the distribution system and the location of the diffusers, dampers, or perforated raised floor tiles. Many times on jobsites we see diffusers positioned directly over racks or in designated hot aisles. The diffusers are installed but their volume dampers are closed or there is an insufficient amount of 'perf' tiles to allow for proper air distribution. These minor installation details may go unnoticed in a traditional data center because the entire room is being cooled. In a hot and cold aisle arrangement, these tiny details may cause hot spots to develop and eventually cause equipment failures. Not only is it important to install the equipment as designed, it is also very important for the design engineer to conduct a very detailed punch list at the completion of the job to make sure all equipment is installed exactly as the plans show.

A hot and cold aisle arrangement is a good way to accommodate the increasing heat densities found in today's data centers. It is a relatively new concept to the data center community and will require education and communication so that people are aware of how they will be affected by this system. It is no longer an issue just for the engineers and facility managers. The IT department needs to be involved and brought up to speed as to what their role will be to implement this system correctly.

Reliability Defined

Reliability is stated in the number of "nines" as a percentage (99.9%, 99.99%), which can be converted to projected hours of downtime per year. A better matrix is to express reliability as a "Probability of Failure" over the 20-year life of a facility as this is more definitive.

Nines Reliability	% Probability of Failure
90% - 1 nine	100
99% - 2 nines	100
99.9% - 3 nines	99.9
99.99% - 4 nines	67
99.999% - 5 nines	10
99.9999% - 6 nines	1

Policy

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Correspondence

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