

in this ISSUE:

Data Center Demand

Data Center Upgrades

High Density Cooling

Generator Run Issues



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Mission Critical Facilities pose numerous design, procurement, construction and commissioning challenges. The introduction article outlines some of these challenges with regard to severe lead times for equipment and how **FEA** has addressed these issues.

We have several projects that involve providing design services where the contractor implemented upgrades within the existing system design constraints. This resulted in meeting the clients' immediate needs, but posed problems in meeting future requirements.

High-density loads are quickly permeating throughout data centers, which has resulted in present air conditioning systems being overtaxed with the result being equipment failures.

This newsletter addresses these issues in detail, which we hope will assist you in operation and design so your mission critical infrastructure continues to provide the redundancy and reliability to meet your company's ever changing and increasingly challenging business objectives.

Data Center Demand

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

The demand for data center space has again far outstripped supply and this phenomenon should continue for the next 3 - 5 years. Not only is **FEA** seeing demand increase for data center facilities, but also the demand for all mission critical facilities has increased. This requirement for redundancy and high reliability is also permeating into general office spaces and other non-critical facilities as companies require continuous up time for all their operations.

Meeting the demand for added mission critical space has been seriously affected by lead times, especially for the equipment necessary for larger facilities. Deliveries for stand-by generators are now 52 weeks and climbing with the deliveries of switchgear and UPS systems in the order of 36 to 40 weeks. These extended deliveries are due to global demand, which has outstripped the available manufacturing capacity. In addition to the manufacturing capacity limitations, we are also finding that the equipment manufacturer's engineering capabilities are being stretched as evidenced by the time required to process orders after award of a contract. It is important to note that many delivery lead times begin after "shop drawing approval" which extends the stated lead

time by 6 to 8 additional weeks.

Whereas the equipment manufacturers are in control of the market as all suppliers are experiencing these excessive lead-times, the major manufacturers have not taken advantage of this increased demand and imposed excessive price increases.

In addition to the equipment delivery problems, professional engineering capabilities have been over extended to the point where mission critical professional design firms cannot meet the demand. This has resulted in firms providing less than complete services especially in the commissioning of the systems, or firms being very selective in the projects that they will pursue.

FEA has concentrated our efforts on our existing clients and still provide extensive designPLUS services after the construction document phase. We also work with clients to address the lead time issue by recommending establishing the complete project team at the initial stages of the project to expedite all the project phases, especially the order placement and delivery of major long lead equipment. With this team approach, **FEA** develops the specifications for all long lead items at the initial stages of the project so all long lead equipment items can be ordered early. We then provide the detailed design working closely with the contractors to resolve any constructibility issues and release the equipment installation work in phases to ensure timely construction.

Data Center Upgrades

by Brian Soucy, P.E.

It is common for a data center designed for a given set of requirements to experience several upgrades over the life of the facility. The initial design should allow for planned upgrades to be easily implemented. However, often times unforeseen operational, organizational or even technical changes require system upgrades above and beyond what may have been planned in the original design.

When these system upgrades are limited in scope or more operational in nature, there can be a tendency to go straight to a contractor without taking the time to design a solution. After a while, a patchwork of several isolated upgrades begins to develop. While going direct to a contractor may be cost effective, we have seen cases where it compromised the overall system and made future upgrades more difficult, costly and at times impossible without a complete shut down of the facility.

Contractors are very good at fixing problems. Tell a contractor you're running out of UPS capacity and they will begin ordering equipment and staffing the job tomorrow to satisfy the need. After all, contractors make their money building things not designing them. However proactive this approach may be, it doesn't necessarily consider the total picture or long-term ramifications.

Involving a design professional in the upgrade process can mean a more thorough analysis. It's not just

a question of whether a particular upgrade can be done but rather should it be done or better yet, how should it be done. It's important to look at the immediate need and also consider the upgrade's impact on the system's flexibility, reliability and maintainability both now and in the future. For example, adding the new UPS system may satisfy the immediate need for more capacity but could also mean that an eventual replacement of an aging, existing UPS system would require a shut down or complex cut-over procedure.

Even seemingly innocuous upgrades require deliberate attention to details. Consider a mechanical contractor installing a CRAC unit. Due to time, money or ambivalence, the contractor chooses to connect to a tap 10 feet away, when the tap he should have used was 30 feet away to allow for maintenance of the chilled water loop without shutting down the CRAC. You can't necessarily fault the contractor; he installed the CRAC and fulfilled his obligation. This is typical of an owner getting what they ask for and not necessarily what they wanted or needed. It also demonstrates the importance of providing appropriate direction either from in-house expertise or from outside design professionals.

Design professionals are adept at evaluating options, presenting those options and making recommendations tailored to specific requirements or design principles and criteria. While contractors can bring an intimate knowledge of the facility to a project, generally they are cost driven and as a result may not explore all options. The best approach is a team

approach that involves both the engineer and the contractor.

Generally speaking, a system upgrade deserves the same attention to design that was given the original system. Providing thoughtful and comprehensive design services is where a design professional can add value to the project team and system upgrade process especially in a mission critical environment.

High Density Cooling

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

The advent of high heat output IT equipment such as blade servers and other devices has resulted in a rethinking of how cooling is delivered to these loads. In the past, a common way of referring to the cooling capability of a data center raised floor was on a watts-per-square-foot basis. In a data center that may have a mixture of legacy equipment as well as new blade servers or other high heat output devices, it has become necessary to rate cooling capacity on a watts-per-rack basis since there can be a large difference in heat load from rack to rack.

Historically, the most common way of cooling a data center has been to pressurize the raised floor with cool air and provide floor grills to disperse cooling air throughout the raised floor area. This concept was viable for loads that were relatively evenly dispersed over the raised floor and had a watt density of 30 to 40 watts per square foot. As loads grew beyond that point, it became neces-

sary to address cooling in a different way. After analysis, it was determined that in most cases cooling only needed to be provided to the fronts of the IT equipment since that is where the intake air openings are. Providing supply air to the exhaust or rear end of the IT equipment was recognized as wasteful and of no real value in cooling the critical equipment. The concept of hot and cold aisles was born and is currently a standard configuration in many data centers with loads above 40 watts per square foot. Again, the assumption is made that the loads are relatively evenly dispersed over the raised floor.

New IT equipment is being deployed in existing data centers that have entirely different cooling requirements than were considered during the original design. The introduction of blade servers has complicated the now traditional hot and cold aisle metric since the loads are not evenly dispersed and are much higher than originally planned for. In some extreme cases, the new load is evenly dispersed but consists of many high wattage loads demanding cooling requirements that far exceed the capabilities of cooling supplied from the raised floor. Engineers and manufacturers of data center cooling equipment have been working on answers to this problem and several mainstream approaches have been developed that can solve many cooling problems. Solutions to cooling based on watts-per-rack has given rise to cooling equipment designed to meet this need. A marriage of the traditional raised floor

cooling concept and newer above floor cooling equipment can provide a viable solution to either spot cooling problems or total high watts-per-square-foot situations. When dealing with rack loads above 1.5 KW per rack, it is definitely time to consider adjacent loads since they will compound the cooling issues and a high density cooling solution may be appropriate. Noting adjacent loads and being careful to allow for proper cooling airflow to the hotter racks can many times permit the design of small and simple layouts without expensive analytical Computational Fluid Dynamic (CFD) modeling. Large and complicated layouts should be analyzed using CFD modeling to ensure that the hotter loads do not "steal" cooling air from other racks. We have been surprised from time to time as to what airflow patterns really exist as determined by CFD analysis.

Various manufacturers have addressed the high density cooling problem in a variety of ways. There are systems that provide above floor cooling solutions based on additional airflow through the equipment, above rack cooling with the use of chilled water or a refrigerant, adjacent to rack cooling with the use of chilled water or a refrigerant, and racks with self contained cooling systems. When evaluating the deployment of any one of these approaches, each of the systems has cost, capacity, ease of deployment, risks, and space issues that must be analyzed to reach a decision that fits with the particular data center being considered.

Generator Run Issues

Generator systems are the first to fail during an emergency; therefore, they need extra attention.

Fuel Storage

FEA recommends 48 hours

We have clients that insist on 60 hours

Large quantities of fuel storage require a fuel-polishing system to keep the fuel fresh.

Long Term Running

Need to monitor oil level closely. The system design needs to address the fact that generators need to be shut down to change oil filters, fuel filters, belts and hoses - especially critical on long runs.

Spare parts

Keep spare filters on site - two sets minimum.

Spare belts, hoses and one fill of all liquids (oil, antifreeze, etc.) need to be on site.

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

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