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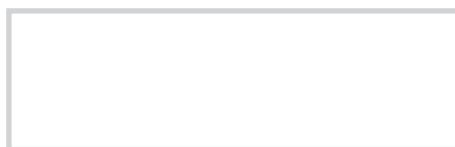
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## Design Concepts Presentations

Facilities Engineering Associates (**FEA**) is a professional engineering firm dedicated to the design of "Mission Critical Facilities" and committed to educating our clients on 7x24xForever design concepts. We have recently presented the basics and benefits of these design concepts at the 7x24xExchange, Society of Broadcast Engineers, Society for Information Managers as well as numerous other companies. If you would like **FEA** to give a presentation at a technical society where you are a member or to information technology, facilities or other personnel in your company, please contact us and we will be pleased to arrange for a presentation.

## Reader Feedback

In the Fall of 2001, Facilities Engineering Associates published our first designPLUS newsletter. Since then, we have received very positive responses to the newsletter's content. In developing the newsletter, we were determined to provide timely information covering topics that would be of general and technical interest regarding 7x24xForever mission critical facilities. We also wanted to share some of the experiences that we have had over the past 30 years regarding mission critical systems which may assist you in the operation and upgrade of your facilities.

We hope that the newsletter fulfills the need for providing more information in this area as we have recently found that "mission critical" design elements are becoming a requirement in seemingly less critical facilities. This is being driven by international markets and the Internet, which have 7x24xForever operational requirements.

The past two newsletters have covered topics ranging from the Spring 7x24 Exchange Conference to information on 9's reliability and diesel fuel shelf life. Future newsletters will include notewor-

thy articles about other mission critical topics including standby generators, UPSs, batteries and air quality regulation changes. This month we are including a management checklist to quickly assess how your facility is operating and different ways to cool high-density equipment racks.

Now that many of you have received two newsletters, we are interested in any comments you may have regarding the content as it relates to technical vs. non-technical information. Any other suggestions are welcomed as well. You can reach me at [lsoucy@feace.com](mailto:lsoucy@feace.com).

During the next few weeks we will endeavor to determine which media best suits your needs. To this end, we will be sending you an email asking if you would like to continue receiving the designPLUS newsletter through the mail or electronically as a PDF file through email. We look forward to your response and hope that you find the newsletter both interesting and informative.

Contact Leo Soucy at **FEA** with any comments or questions.  
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# Rack Cooling

Data center technology is changing at an exponential rate. In order to maintain the acceptable environment for today's and tomorrow's data centers, the details of cooling technology must change at an even faster rate in order to stay ahead of the equipment upgrades.

Not too many years ago, cooling of mainframe computers was accomplished by piping chilled water directly to the processor. Later designs consisted of processors that could be cooled with cool air and the chilled water was used to generate conditioned air either by remote air handling units in a separate mechanical room or by computer room cooling units (CRU's) strategically located throughout the floor. Conditioned air was distributed under the raised floor and entered the units through access openings at the bottom. Heated air flowed out the top of the unit and returned to the A/C units using the room as a return plenum.

Server units are comprised of microprocessors that consume power and generate heat. A typical data center produces heat in the range of 60 watts/sq. ft. Heat loads in the range of 300 watts/sq. ft. are now being projected by the year 2008. All this data processing power is neatly packaged in server units that are then packed into racks in either a horizontal or vertical configuration. The individual server units are so designed that they are capable of removing the heat generated by the microprocessors and maintaining a stable internal operational environment.

All the concentrated heat that is being generated now represents a major change in the configuration of the cooling system in the data center. A detailed investigation must be conducted in order to determine the method in which the server emits heat and properly remove this heat from the immediate area of the

servers. No longer can we just blow cold air into the under floor area and remove heated air from the overhead area. The myriad of configurations that the rack servers can be assembled within a data center can very quickly create problem (hot) areas.

The difficult part of cooling a data center is to finely tune the systems to distribute the correct amount of conditioned air to the right locations in order to eliminate hot and cold spots. As most data centers are fluid situations, after each equipment upgrade the HVAC tuning process must start all over again.

The following are several methods that are being used to provide cooling air in a state of the art data center.

## Conventional Overhead Distribution:

Air can be supplied from remote air handlers and distributed in overhead ductwork. Supply diffusers should be arranged in a manner that cooling air is directed to the air intakes of the server equipment. Return air will be through the room and back to the air handler through ductwork.

## Up Flow/Down Flow CRU's:

Air can be supplied directly into the room with up-flow floor mounted CRU's and returned to the front of the unit or air can be routed under the raised floor with down flow CRU's and emitted at perforated floor tile diffusers in the location desired. The most popular method is the down flow scenario and final distribution of the cooling air can be accomplished in several different ways. Server racks are typically arranged in aisles. Floor diffusers can be utilized in the aisles between racks to provide the cooling air. Floor diffusers can be of three typical designs depending on the amount of air required at the specific location. Simple perforated floor tiles can be utilized or, for more flow, newer cast aluminum floor tiles with larger openings can be used to provide increased open area and increased flow. For floor systems that may have low static pressure or to provide increased velocity at the floor tile, fan powered tiles can be incorporated.

## Specialty Racks:

In addition to various types of floor diffusers, the type of rack and the placement of equipment in the rack can impact cooling efficiency. Racks are now available that provide air distribution within the rack by routing cool supply air in the rack taken in at a low level and exhausting it at the top after it has been distributed evenly with a system of baffles within the cabinet. Internal fans are usually employed to assist the distribution process. When using this type of system, care must be taken to insure that the distribution fans are redundant and that the internal cabinet temperature is monitored to be sure over temperature conditions do not exist.

## Hot and Cold Aisles:

The establishment of hot and cold aisles is another technique that can be employed where high heat concentrations are present. The equipment within the rack is arranged in such a way that the intakes are on one side of the rack and the exhausts are on the opposite side. The racks are arranged with the backs facing one another creating alternating hot and cold aisles. The advantage of this configuration is that the cooling air from the floor tiles in the cold aisle is not mixing with warm air sources from random pieces of equipment exhausting into the cool air stream. All heated air would then return to the CRU's using the hot aisle and room as a return plenum. The hot and cold aisle scenario can be used with any of the above distribution techniques.

With the heat densities increasing at the rapid pace set by today's ever expanding requirement to process data faster, the establishment and maintenance of the data center environment is a critical item. Attention to the details of how heat is effectively removed from the rack servers and the maintaining of an acceptable operating environment surrounding the cabinetry is both art and science. The time to act in establishing the environment that will accommodate the upgrades of the data center is before the problem occurs.

# 7x24xForever Facility Evaluation Check List

The following check list will allow the reader to get a quick snapshot of the 7x24xForever viability of their facility. It is not totally comprehensive and has been generalized to cover a variety of applications. Such a list could be custom written for a specific facility and would provide valuable information for the manager. The questions are intended to be answered by a responsible person tasked with maintaining the facility.

Maintenance	Last Test/Maint Date	Critical Load at Risk When Performing Maintenance	Ability to Replace w/o Increase in Risk to Critical Load
UPS			
Generators			
Chillers			
Cooling Towers			
Pumps			
Valves			
Cooling Units			
Automatic Transfer Switch			
Circuit Breakers			

How the Data Center is operated as well as staff training can affect system reliability and 7x24xForever availability. The following items are indicators of attention to detail and the ability to react to situations that may threaten the availability of the facility.

Operations	Last Test/Maint Date	Critical Load at Risk When Performing Maintenance	Ability to Replace w/o Increase in Risk to Critical Load
Simulated power failure			
Generators at full load			
Staff at full strength			
Cross training elec/mech			
Posted system documentation			
Equipment identification			
Dual Power cord: load update			
InfraRed reading on panels			
Circuit Breakers			

## Interesting Facts - Factory Witness Tests:

Factory witness tests of equipment should include all ancillary equipment including mufflers installed on generators, filters on electrical equipment, etc. as these can affect the performance of the equipment. For example, a diesel engine powering a generator was so marginal that when the muffler was installed at the site it required additional adjustment to meet the design specifications. The unit was factory tested without the muffler.

Where possible, test future capabilities. A section of switchgear was to be provided with spare cubicles to receive 1,600 amp breakers. Only 1,200 amp breakers could be installed. This was detected at the factory and the cubicle was re-worked prior to shipment. We verified the revision during the on-site integration test.

Secure a penalty clause if the equipment or system is not available for witness testing on the stated day. The system should have been already started up and tested. You are at the factory to witness proper system operation not initial start-up.

Test everything. If a UPS consists of parallel modules, test and adjust each module individually. Once the modules are connected to the system cabinet, it may be difficult to determine if each module is performing as specified as other module may mask any problems.