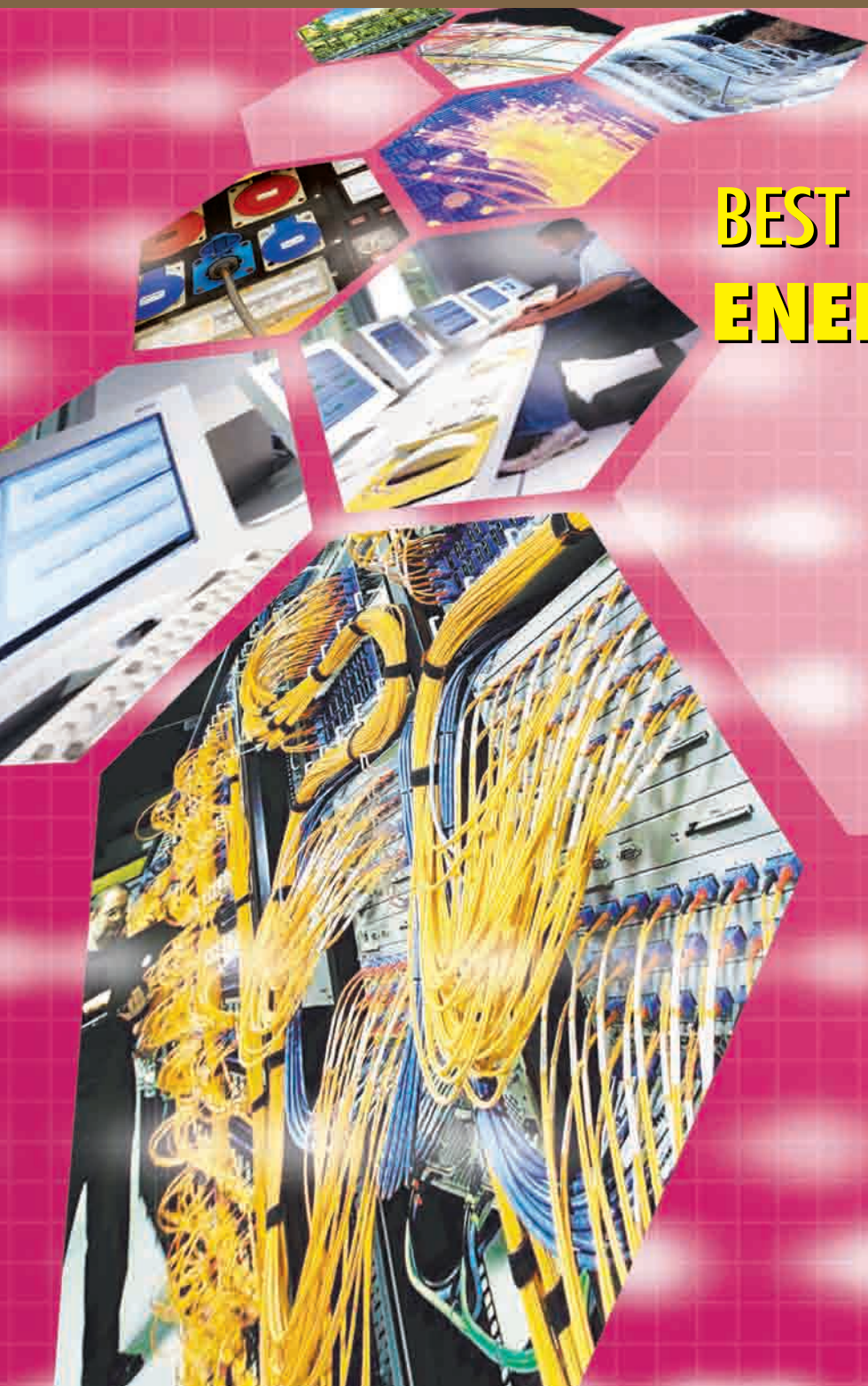


THE MAGAZINE OF 7x24 EXCHANGE INTERNATIONAL

NewsLink

FALL 2006



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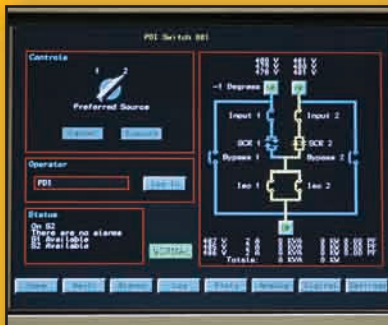
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by Robert J. Cassiliano

Chairman's Letter

7x24 Exchange's most valuable asset to Mission Critical Industry professionals has been to conduct a premier industry conference bi-annually each spring and fall. Although our conference ratings are continually outstanding regarding the value to conference participants 7x24 Exchange has always wanted to provide more. The Board of Directors had a strategic plan developed which included a section focused on providing increasing value to our membership through additional services. This year the Board acted on that plan by approving funding to enhance the 7x24 Exchange website and to begin to transform the newsletter, NewsLink, into an industry publication. To that end the following website improvements have been implemented:

- Easier site navigation
- Career Center for job & resume postings
- Member Forum for information exchange
- Conference Website

NewsLink has added technical papers and advertisements to all editions to provide additional educational content to Newslink readers and information regarding new products and services.

As for the 7x24 Exchange Conference the Board is adding some new features based on feedback we have received from conference participants. The following content has been added for the Fall Conference being held at the Hyatt Regency Scottsdale at Gainey Ranch, Scottsdale, AZ November 12 – 15, 2006:

- Additional Tutorials on Sunday
- Tutorials on Monday & Tuesday
- A Virtual Tour on Tuesday
- A Common Hospitality Exhibition on Monday Evening (Spring 2007)

The changes to the Website and Newslink are designed to supplement the bi-annual conferences in providing a valuable information exchange to our membership and other industry professionals. The changes to the conference are designed to add content that provides value to conference participants and their companies.

The Board of Directors continually monitors the pulse of the membership and conference participants to assist in directing the organization toward improvements that add value.

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7x24 NewsLink – Nov 2006

Best Practices for an Energy-Efficient Data Center



by David E. Perkins

***Abstract** – Power consumption among datacenters is growing at a rapid pace and energy efficiency has become an issue among operators and policy makers. In July 2006, the House approved a bill for a study of energy efficient datacenters. Support infrastructure for datacenters that include the UPS and cooling equipment can account for 50% or more of total power consumption, with significant room for improvement. Flywheel UPS systems based on line interactive topology are extremely efficient and are being chosen to power datacenters globally. In addition to their compact size, these UPS have wider operating temperature range relative to traditional battery-based UPS and allow the use of reduced capacity air-conditioning equipment.*

Background

Most IT professionals are aware of the effect that power consumption and cooling have on operational costs. However, according to a November 2005 survey of more than 1,100 datacenter organizations¹, fewer than 29 percent of respondents indicated that business management was investigating power and cooling as a way to lower operational costs. Similarly, 62 percent of respondents said that power consumption and cooling issues did not affect server purchase decisions in the last year.

Datacenter power consumption is increasing at a staggering rate – so much so that the US House of Representatives has passed legislation requiring the US Environmental Protection Agency (EPA) to study the issue of energy consumption in datacenters. HR 5646 reads, in part, that the EPA study shall include “recommendations regarding potential incentives and voluntary programs that could be used to advance the adoption of energy efficient datacenters and computing.”

In 1992 the EPA ENERGY STAR program began as a voluntary labeling program designed to identify and promote energy-efficient products to reduce greenhouse gas emissions. Computers and monitors were the first labeled products, followed by major appliances, office equipment, lighting, home electronics, and more. EPA has now extended the label to cover new homes and commercial and industrial buildings.

As a result of the actions to be taken under HR 5646, we may see servers and IT infrastructure equipment as the next items added to the list.

Standardization of energy consumption ratings and heightened awareness of power consumption costs of IT equipment will be valuable for assisting IT professionals in comparative evaluation of energy life-cycle costs. However, when or if such voluntary labeling practices are implemented for IT equipment is anyone’s guess. In the interim, it make sense for IT professionals to adopt common sense practices that

encourage reduced consumption of diminishing resources, reduced carbon emissions from power generation, and lead to improvements to the bottom line as the cost of energy and datacenter operations continue to increase.

A number of simple steps may be used today when outfitting a new datacenter or expanding an existing datacenter. These include but are not limited to:

- Specification of server equipment with high-efficiency power supplies. Power supply efficiencies can vary between 65% for the worst offenders and up to 95% for the most efficient designs.
- Use blanking plates in unused rack space to optimize cooling airflow.
- Keep airflow paths clean and use good cable routing practices to keep airflow paths clear.
- Larger datacenters with multiple cooling systems may require periodic rebalancing of the air conditioning units. Significant energy may be wasted when one A/C unit is attempting to dehumidify an area while another is adding humidity.

One often overlooked factor when outfitting a new datacenter or when expanding capacity is the choice of UPS topology. Today, new UPS architectures are available that can further improve energy cost savings in conjunction with the above practices.

Efficiency of UPS Topologies & Technologies

It is important to consider the loading factors on UPS equipment when comparing operational efficiency. An excellent white paper by APC discusses this point in detail². We compare average industry efficiency performance data at 25-100% load for various static UPS topologies and technologies that present relatively low harmonic distortion to the utility supply. Included in this comparison are:

- Transformer-less series on-line double conversion with IGBT rectifier and lead-acid battery energy storage
- Series on-line double conversion with thyristor rectifier, 5th harmonic filter, transformer and lead-acid battery energy storage
- Line-interactive topology with medium speed flywheel energy storage

Typical efficiency data achieved in operation									
Topology	Rectifier	Inverter	Galvanic Isolation	Input PF 100% Load	THCD Input	Efficiency kW/(in) kW(out) Load			
						25%	50%	75%	100%
Series on-line	IGBT	IGBT	No	0.99	<2%	82-85%	87-89%	88-90%	89-91%
Series on-line	Thyristor	IGBT	Yes	0.85	4%	80-90%	91-93%	92-93%	91-93%
Line Interactive	Two-way IGBT //		No	0.99	<4%	93-94%	96-97%	97-98%	97-98%

Figure 1: Typical Efficiency Data Achieved in Operation

These data points are presented in graphical form below.

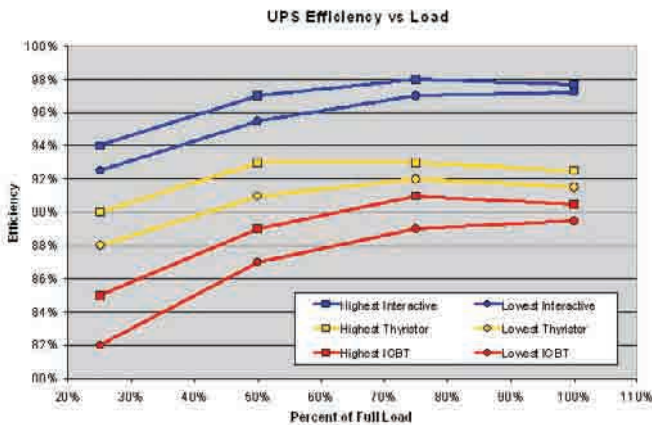


Figure 2: UPS Efficiency vs Load

For a simple comparison of the economic impact of these losses we can take the average efficiency of each topology at 75% load and convert to kWh/yr for an IT equipment load of 900-kW. Note also that the energy dissipated by the UPS must be absorbed by the facility cooling system. COP is the ratio of cooling capacity to power input so each watt of additional cooling requires about 33% additional electricity consumption.

The energy consumption and cost of energy for this UPS and cooling system are given in the following table. In this scenario, the annual savings of the line-interactive topology is more nearly \$54,000.

Typical efficiency data achieved in operation							
Topology	Rectifier	Inverter	Average Efficiency 75% Load	Losses kW	Losses kWh per year	Annual Cost \$US 0.07 per kWh	Annual Cost of Losses \$US
Series on-line	Thyristor	IGBT	93%	68	591,300	\$4,139	\$53,808
Line Interactive	Two-way IGBT //		96%	23	197,100	\$1,379	\$17,836

Calculation for a 1200 kVA UPS at unity pf and 75% load = 900 kW IT load

Figure 3: Typical Efficiency Data Achieved in Operation (75% Efficiency Load)

Consider next the scenario which is characteristic of a fully redundant, dual corded Tier IV datacenter. In this case, each redundant UPS may be carrying only half or less of the total IT load³. The annual energy cost savings in this scenario is more than \$67,000.

Typical efficiency data achieved in Tier IV operation							
Topology	Rectifier	Inverter	Average Efficiency 40% Load	Losses kW	Losses kWh per year	Annual Cost \$US 0.07 per kWh	Annual Cost of Losses \$US
Series on-line	IGBT	IGBT	86%	132	1,150,525	\$81,237	\$105,608
Series on-line	Thyristor	IGBT	91%	89	773,683	\$54,158	\$70,405
Line Interactive	Two-way IGBT //		95%	48	416,275	\$29,139	\$37,881

Calculation for redundant 1200 kVA UPS at unity pf and 40% load per module = 960 kW IT load

Figure 4: Typical Efficiency Data Achieved in Operation (40% Efficiency Load)

The difference in losses can result in a payback time of as little as 4 years depending upon the local cost of electricity and the market price of UPS hardware.

In addition to bottom line savings, the reduced power consumption has ecological benefit in terms of reduce greenhouse gas emissions. Each kWh of electricity production represents 1.58-lb of CO₂⁴. For the cases defined above, the increased UPS efficiency results in reduced CO₂ emissions of 934,000-lb and 1,176,000-lb, respectively.

Additional Cooling Savings from Flywheels

Most datacenter managers are aware of the sensitive life-temperature relationship of VRLA and other batteries. Since many larger UPS-battery installations are housed in separate equipment rooms, it is possible to take advantage of the higher allowable operating temperature range of flywheel based UPS systems. Most flywheel manufacturers specify an allowable operating temperature of 40C with no ill effects on life. This provides the user with the opportunity to raise the thermostat from the battery manufacturer's recommended setting of 25C in these areas for additional cooling cost savings.

Summary

Datacenters are huge consumers of power and producers of heat. For every watt that a microprocessor consumes the datacenter will consume and reject between 1.3 and 2.3 watts depending on equipment efficiency. With the trend in datacenter IT loads approaching 10-MW or more, any contribution to saving energy from the power delivery or cooling infrastructure will become increasingly important.

Careful selection of IT equipment can have a pronounced effect on datacenter operational costs. This paper shows that the latest UPS technologies employing line-interactive topologies offer superior efficiency performance over conventional series on-line systems. Efficiency improvements of 4-12% can be achieved depending on the extent to which the UPS is loaded. Lightly loaded UPS such as those found in Tier IV facilities will benefit the most but considerable savings can be achieved even with highly loaded units.

David E. Perkins is the Chief Technology Officer of Active Power, Inc. He can be reached at dperkins@activepower.com

¹Power Consumption and Cooling in the Datacenter: A Survey, Ziff Davis Media

²Rasmussen, N., Electrical Efficiency Modeling of Datacenters, White Paper #113, APC, 2005.

³Bitterlin, I., The importance of 'partial load' efficiency for power systems in critical datacenter applications, White Paper, Active Power, Inc., 2006.

⁴Unit Conversions, Emissions Factors, and Other Reference Data Report, US Environmental Protection Agency, Nov 2004.



Safety and Risk Issues with Pre-Action Sprinkler Systems

by Nicholas Fioravante and Mark Gasser

An on-going investigation into failures of automatic sprinkler systems has uncovered concerns with “Pre-Action Sprinkler” systems that could lead to (a) water discharge during testing, (b) sprinkler head obstruction during fires, (c) inadequate water flow during fires and (d) possible catastrophic failures. Pre-action sprinkler systems are generally used when there is a concern with inadvertent discharge of water (datacenters, server rooms, communication rooms, call centers, mail processing facilities, etc.). All systems that were investigated were installed to satisfy National Fire Protection Association (NFPA) codes. The investigation, while based in the Mid-Atlantic region, included a sample of systems that were installed in mission critical facilities throughout the United States. All systems that were included in the investigation had been in operation on average less than 7 years with several systems being in service less than 2 years.

Concerns were identified in over 80% of the systems that were investigated. “Dry-pipe” pre-action sprinkler systems were found to contain significant amounts of water and corrosion. The corrosion, in many cases, was of sufficient magnitude and extent to reduce water flow and lead to sprinkler head obstruction. Sprinkler head obstruction and inadequate water flow are a safety concern for the occupants of the facility and increases the risk of property damage. In addition, over 10% of the inspected systems had existing leaks such that water discharge during testing represented an actual risk to sensitive computer/server equipment.

Introduction

Generally, three types of automatic sprinkler systems are used throughout the United States, per building and NFPA codes: Wet-Pipe Sprinkler systems, Dry-Pipe Sprinkler systems and Pre-Action Sprinkler systems. Wet-pipe sprinkler systems are the most commonly used automatic sprinkler systems and are used to protect office spaces and hazardous areas. While limited in use, wet-pipe sprinkler systems can also be found in datacenters. Dry-pipe sprinkler systems are required in unheated areas such as garages and attic spaces. Pre-action sprinkler systems are generally used when there is a concern with inadvertent discharge of water. A pre-action sprinkler system also requires a supporting detection system. In a pre-action sprinkler system, the sprinkler pipe is dry and supervised by air to detect leaks while the system is in standby. In the event of a fire, a pre-action sprinkler system requires at least two actions before water is discharged. The detection system must activate to open a flow control valve, thereby

allowing water to fill the sprinkler pipe. In addition, the heat from the fire opens one sprinkler head at a time and allows water to flow.

Many mission critical areas that contain computer related equipment are protected by both a gas suppression system and a pre-action sprinkler system. If the IT manager does not want water around his equipment but building codes require a sprinkler system, a pre-action sprinkler system is used. In using the dual systems, it is generally believed that the gas suppression system would extinguish any fire long before the sprinkler system would actuate.

As part of the routine maintenance, sprinkler systems should be subjected to a flow test, either quarterly or annually based on the type of system. Typically, in the past, if a leak of minor consequence was observed during testing, the pipe section was replaced without much consideration to the cause of the leak. However, over the last several years, as facility and IT personnel have experienced sprinkler system leaks in sensitive areas of their operation, they have been challenged to identify the cause of the leak and the extent of the risk to the facility. Thus, sprinkler systems failures are receiving increased attention.

So much has been written about Microbiologically Influenced Corrosion (MIC) that MIC is often considered the cause of any pre-mature sprinkler system failures. The “do-it-yourself” microbiology tests kits are being used to further the MIC cause. Unfortunately, MIC is not the only source of corrosion in sprinkler systems. Measures to address MIC may not prevent other types of corrosion. It is important to establish the root cause and any contributing factors before embarking on a costly replacement and maintenance program. Only by truly understanding the root cause, can you be assured that any corrective actions will provide long-term reliable service from your sprinkler system.

Investigation Methodology

Our investigations consist of (a) visual inspections of the interior condition of sprinkler pipe and (b) the collection of pipe and water samples for chemical, microbiological, and metallurgical examination and analysis. Prior to any inspection or sampling, an assessment of the inspection and sampling locations is performed to identify any risks to operations.

In many cases, risk mitigation measures such water collection devices and protection of sensitive equipment, are implemented during the actual inspection and sampling.



To perform a visual inspection, the main drain and auxiliary drains of the pre-action system are opened. Water discharged from main and auxiliary drains is collected and the quantity is estimated. The pre-action sprinkler piping is then opened for visual inspection. Any water remaining in the pipe is also collected and the quantity estimated when the pipe is disassembled. A borescope and/or videoscope is then used to inspect, photograph and video record the pipe interior. Observations are documented on videotape and digital still photographs.

Pipe and/or water samples are collected and sent to an independent laboratory for chemical, microbiological, and metallurgical testing, examination, and analysis. Each pipe sample collected had, at some level, visual corrosion deposits. The corrosion deposit provides a more accurate source (the deposit material itself at the base of the corrosion site) for microbial culturing than a water sample (i.e., using a water sample to determine the "influence" of the microbiology, if any, on the corrosion process gives less accurate results). Pipe samples are also collected and sent to our materials laboratory for confirmatory materials and metallurgical testing and analysis.



facilities throughout the United States. Of the pre-action sprinkler systems that were investigated, 80% had standing/stagnant water inside the pipe at levels greater than would be normally retained by the rolled groove of the pipe. The amount of water collected from auxiliary drains and open fittings (after the main drain had been opened) ranged from 10-300 gallons.

The design and installation requirements for pre-action sprinkler systems are defined by NFPA 13. The basic design and installation intent is for the piping of pre-action sprinkler systems to be dry. The NFPA codes require "All sprinkler pipe and fittings shall be so installed that the system can be drained." In addition, "Auxiliary drains shall be provided where a change in piping direction prevents drainage of system piping through the main drain." The NFPA codes do not specifically require that pre-action system piping be sloped or pitched back to the main drain, when installed in heated spaces. Therefore, the standard industry practice is to install pre-action system piping (in heated spaces) nominally level. In addition, the NFPA codes require that a pre-action sprinkler system be subjected to an annual flow test. Thus, our investigation found that systems that were installed and tested to satisfy National Fire Protection Association (NFPA) codes contained significant amounts of water.

Results

Our investigations have uncovered several concerns with pre-action sprinkler systems that are installed in mission critical

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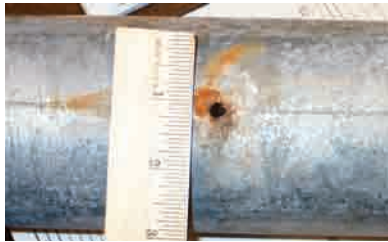
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Of the systems with standing water, 100% had moderate to heavy silt-like deposits spread uniformly along the lower half of the pipe with 80% of the systems having some evidence of active corrosion sites (localized tubercles or nodules).

Pipe samples taken from systems with active corrosion sites showed pitting of the interior pipe walls, i.e. pipe wall loss ranging from 10-95%. The majority of the samples had pits with pipe wall loss in the 20-70% range.



Through-wall holes were uncovered in 10% of the systems that were inspected.



Corrosion and pitting were discovered in both Schedule 10 and Schedule 40 piping.

The pipes contained sufficient corrosion and debris to potentially

obstruct sprinkler heads during a system actuation.

Water samples taken from the systems were analyzed for water chemistry data. Microbiology samples were cultured from the active corrosion sites. Water chemistry and Microbiologically Influenced Corrosion (MIC) were determined



not to be primary causative factors in the advanced nature of the

corrosion for the systems that were included in this investigation.



Conclusions

Based on the aforementioned observations and

findings, our conclusion is that there is a considerable likelihood that pre-action sprinkler systems approved for use by the local authorities have standing/stagnant water in the piping. Standing water in the pipe, in a relatively short time, can lead to the formation of active corrosion sites. These active corrosion sites can cause through-wall holes and sufficient pipe wall loss to result in leaks during system testing and possibly pipe failures. In addition, the corrosion products can cause obstructions to sprinkler heads or restrict water flow.

Thin-wall pipe, Schedule 10 and Schedule 40 pipe were all susceptible to retaining water and thus, corrosion. Galvanized piping was more susceptible to corrosion than black steel pipe. While a majority of the inspections and sampling were conducted in main lines, branch lines appear susceptible to similar corrosion issues.

Recommendations

Given these results and possible concerns, it is recommended that a representative sample inspection be conducted of pre-action sprinkler systems throughout the facility. With appropriate risk management controls, an inspection should include (1) opening the main and auxiliary drains and collecting and measuring any and all water, and (2) visually inspecting interior portions of the sprinkler piping. If water is observed or the piping exhibits signs of corrosion, further investigation and remedial actions is warranted.

If a piping failure (through-wall hole, leak) is experienced during the annual flow test, a full investigation is recommended. The piping with the leak should not be replaced without further investigation.

If consideration is being given to holding a party responsible for system failures, there are protocols and procedures that should be followed for preserving evidence during inspection and testing. A key factor in assessing responsibility is the determination of root cause.

Unfortunately, if the pre-action sprinkler system piping is experiencing corrosion, there are very few options available. Flushing the system could force the corrosion products to the sprinkler heads and thus, create a safety issue. Chemical treatments are costly and do not reverse the damage that has occurred. Re-sloping the piping and removing all water would stop the corrosion process but again does repair the damage. It has been our experience that the most cost-effective solution is to determine the extent of the degraded piping and replace the pipe.

New installations or replacements should consider either a wet sprinkler system or a wet cycling sprinkler system. If a pre-action sprinkler system is desired, nitrogen should be considered versus compressed air for the supervisory function. Additionally, cut groove joints should be considered in lieu of rolled grooves and test isolation valves should be provided to allow a full flow trip test without flooding the piping over critical areas. All pre-action piping should be installed and maintained sufficiently sloped to permit full draining after any test or system actuation.

It should also be noted that gas suppression systems are not without issue. Inspections of gas suppression systems have identified corrosion in the gas system piping. The following is an example of the internal piping covered in a thin layer of corrosion products in a "clean agent" gas suppression system. The corrosion products could potentially be discharged into the room with the gas suppression agents. Consideration should be given to annually inspecting the internal piping of the gas suppression systems.

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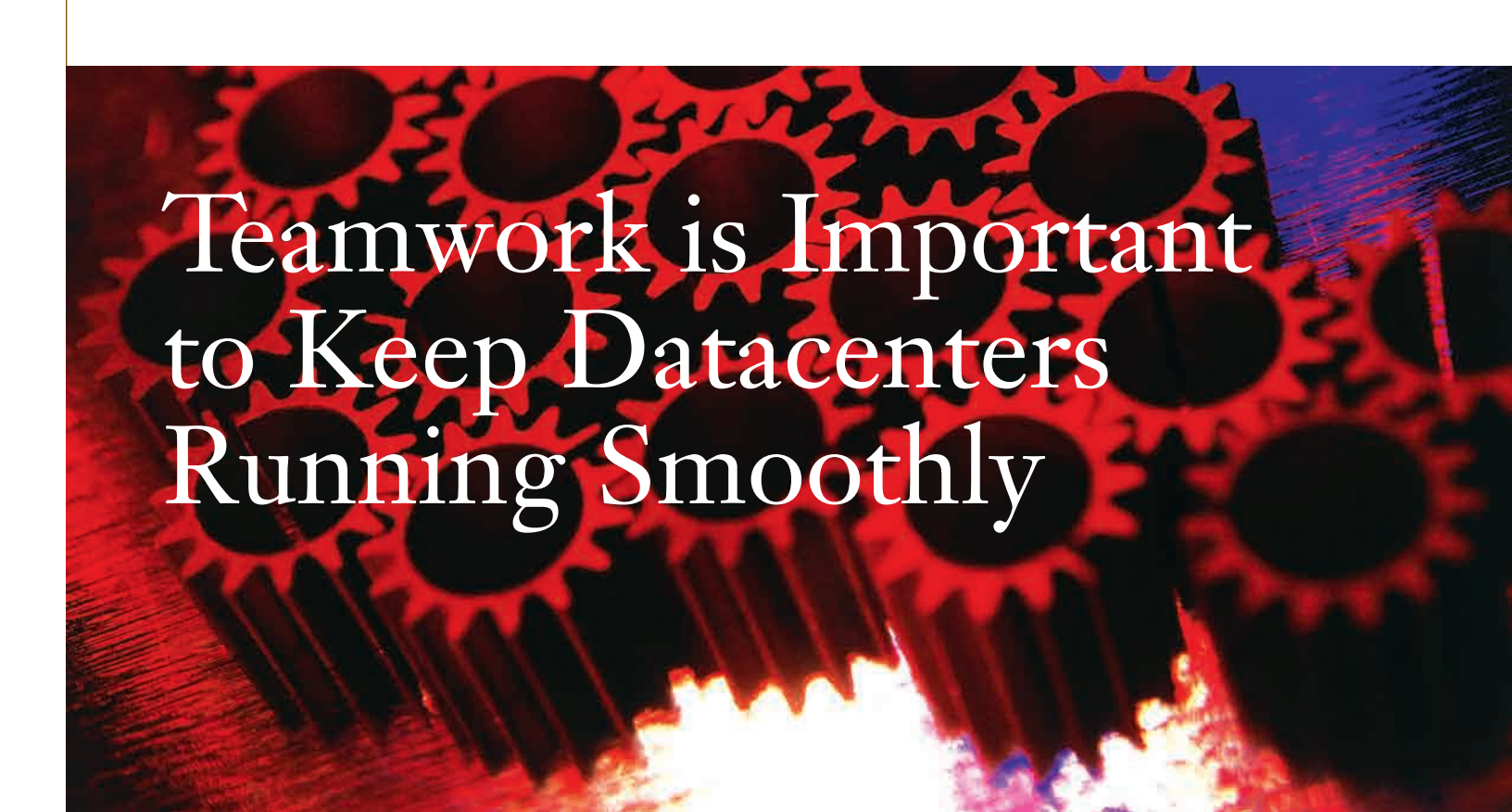
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Teamwork is Important to Keep Datacenters Running Smoothly

by Sean Nicholson

In baseball, a shortstop who commits 10 errors a season and fails at the plate seven times out of 10 would rank at the top of his profession.

If this same shortstop were running a datacenter, he'd be sent down to the low minors before he drew his first paycheck.

Datacenters have never been tolerant of errors – and the field is getting stricter all the time. Standards have evolved to the point where datacenter managers target 99.999 percent “uptime” for the servers and storage needed to run enterprise systems. Improvement to this so-called “five nines” level of reliability is expensive. And with humans involved, the ever increasing complexity of datacenter technology pushes up the rate of human error.

Investments in new technology can eliminate many of the errors that commonly afflict today's enterprise systems. But technology cannot get the job done by itself. In datacenters, as in baseball, teamwork is a critical factor to the entity's ultimate success.

IT vs. Facilities

The challenges in maintaining reliability within the datacenter are exacerbated by the division of teams that run it. General accounting rules (COBIT) specify the Facilities Department, typically the group that handles the buildings and space in which the datacenter exists, as the organization responsible for the datacenter's physical space. However, the IT Department, with its focus on engineering disciplines, is where the knowledge exists about the high technology equipment installed in the datacenter space (and on which the datacenter relies).

The culture difference between teams, as well as the attention paid by upper management, can cause separation and conflict. Often, upper management is attracted by the possibilities that high technology brings. They have energy and focus on IT to

produce advances, and make the business more competitive – and that is noticed by the Facilities staff. As one Facilities worker we talked to mentioned – “Those IT guys have potted plants in their office space. We don't get potted plants.” Having teams work together for the sake of efficiency and quality can be difficult with over-arching culture clash established in an organization.

The objectives of the teams can be in conflict as well. Incentives have been set up for IT, fueled by government regulations like Sarbanes-Oxley, to keep servers running at all costs, where Facilities is concerned with the integrity of the building and its assets. If a fire breaks out in the datacenter space, the IT guys may be trying to determine which specific servers can be shut down to put out the fire, whereas the Facilities guys will be looking to shut down all power to the floor.

Challenges Ahead

Added to this are management's objectives, which center on more professional and robust management of the services provided by IT, in the form of IT Service Management. ITSM involves the next level of proactive management of IT, as a set of services that achieve and align with business goals. It includes the definition and management of associated service level arrangements, maintenance requirements, and in some cases, helps define services which directly impact the level of revenue for the business.

Businesses that want ITSM are becoming increasingly dependent on IT to deliver expansive data storage and computing services, from typical finance and communications support, and critical manufacturing applications, to systems used directly by customers, as in the case of online entertainment and content providers.

With strong management pressure, IT leadership is in a bind to provide more and more services within the datacenter infrastructure. This leaves some in IT exasperated: “I don’t want management to see the datacenter floor. We are running out of cooling capacity, but he’s going to look at all of the open rack space and say ‘What’s the problem?’ “

Managing Change

Answers to these problems may be found in the workings of a wide variety of other complex organizations, where strict process is defined to handle the complexity. Usually, datacenter process management revolves around Change, as changes are the number one cause of unexpected outage in datacenters. Understanding how changes are made to the datacenter, and how the change will impact the systems running in the datacenter, are key ingredients to keeping high levels of reliability – and preserving uptime.

Having a detailed understanding of what equipment exists in the datacenter infrastructure is also an important part of teamwork, as this promotes communication among the members of the team. Discussion about problems, and determining the best solutions, should not be encumbered by problems in getting information. Within the datacenter, this is in the realm of Configuration Management, where the current state of the infrastructure is well documented and understood. Understanding what exists brings greater understanding to those that are trying to fix the present and to plan out the future.

Managing Culture

Team integration or established dedicated teams may also be very important to achieving the future goals of the datacenter. The emergence of the Datacenter Team, where goals, objectives and incentives are properly aligned with the goals of the business, is a very promising trend, and one that aligns with ITSM. The Uptime Institute’s ideas around “Integrated Critical Environments” teams, where engineers from different disciplines collaborate and plan, reflect this idea.

Tools that support and enforce the process for change, and the accurate communication of the state of the configuration are absolutely necessary to run an efficient datacenter organization. The complexity that exists in datacenters today, and the promise of more and more complexity in the future, indeed call for more than the latest version of Visio or Excel.

The Datacenter Team needs to know not only what changes are occurring but who reviewed and approved the change, and how long it took for the change to take place – how can the process be refined or tuned? The team needs to know what the current infrastructure looks like, not only for the purposes of asset inventories but also to find the devices that fail – who else will be affected by this hardware failure? The team needs to know what the business requirements are for IT, and how to plan for infrastructure expansion – how do I justify future infrastructure needs to management?

A Datacenter Revolution

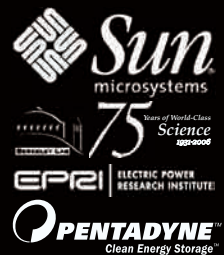
As corporate America’s appetite for computing power increases, datacenters themselves will evolve. Many organizations will try to build bigger datacenters; others will optimize the use of their existing back-office environments. But adding datacenter capacity is complex and expensive. Today’s servers pack more punch in a smaller space, but they also require much more power, cooling and space planning than yesterday’s.

Datacenters face major challenges in the years ahead. Managers must do their best to keep costs down and plan for the future – all the while maintaining the required “five nines” level of reliability. The tools and techniques that bring IT, Facilities and Management together are needed more than ever to tackle these issues as a team.

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Ribbon Optical Cable in the LAN and Datacenter

by Doug Coleman

Local area network (LAN) campus and building backbones as well as datacenter backbones are migrating to higher cabled fiber counts to meet increasing system bandwidth needs. Ribbon optical cables are now being deployed to meet this need, as they provide the highest fiber density relative to cable size, maximize utilization of pathway and spaces and facilitate ease of termination.

Stranded Loose Tube Cable and Tight-Buffered Cable Designs

Stranded loose tube cable has been the dominant optical fiber cable designed deployed in campus backbones for more than 25 years. In recent years, this cable design has also emerged as a major choice for building backbones where riser and plenum flame ratings are required. The loose tube cable has demonstrated exceptional and reliable mechanical, environmental and optical performance that has been

unmatched by other optical cable designs as well as other media types. The loose tube cable design typically consists of multiple buffer tubes that contain one to 12 fibers and are stranded around a central member. High tensile strength yarns are helically applied around the stranded buffer tubes. Contingent upon the deployment location, a non-flame or flame-retardant jacket is applied. Recent technology innovations have resulted in a completely gel-free design that contains no filling or flooding compounds, eliminating the time and labor associated with cleaning and terminating fibers. See Figure 1.

Historically, tight-buffered cables have been limited to indoor premises applications. The cable has normally been deployed in low-fiber-count (24 or less fibers) building and datacenter backbone and interconnect (2 or less fibers) applications. The cable design typically consists of multiple 900 micron tight-buffered fibers stranded around a central element with tensile strength yarns and a flame-retardant jacket applied. See Figure 2.

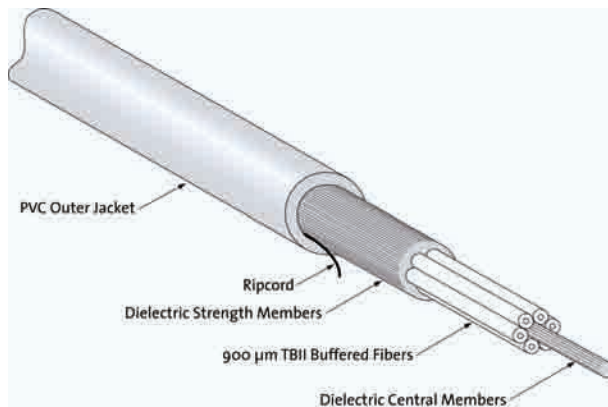


Figure 1: Gel-Free Cable

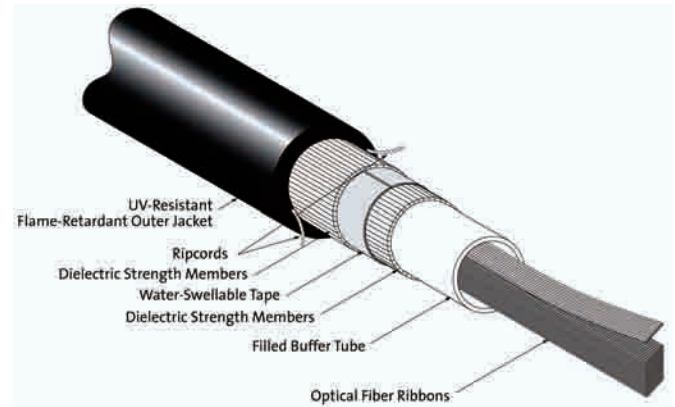


Figure 2: Tight-Buffered Cable

Ribbon Optical Cable Design

Ribbon optical cable has recently emerged as a primary cable design choice for deployment in campus, building and datacenter backbone applications where fiber counts of more than 24 are required. The cable design offers robust performance equivalent to the stranded loose tube cable. It provides the maximum fiber density relative to cable diameter when compared to stranded loose tube and tight-buffered cable designs. The cable design characteristically consists of 12 to 216 fibers organized inside a central tube. For indoor designs, helically stranded strength elements provide tensile strengths of up to 600 lbf. The 12-fiber ribbons are readily accessible and identifiable with ribbon identification numbers and TIA-598 compliant fiber color coding. A non-flame retardant jacket material is typically used in outside plant applications. Specially formulated flame-retardant outer jackets are used for indoor applications, which allow the cable design to meet the requirements of the NFPA-262 flame test for ribbon plenum cables and the requirements of the UL-1666 flame test for ribbon riser cables. Like the stranded loose tube cable, completely gel-free designs are available. See Figure 3.

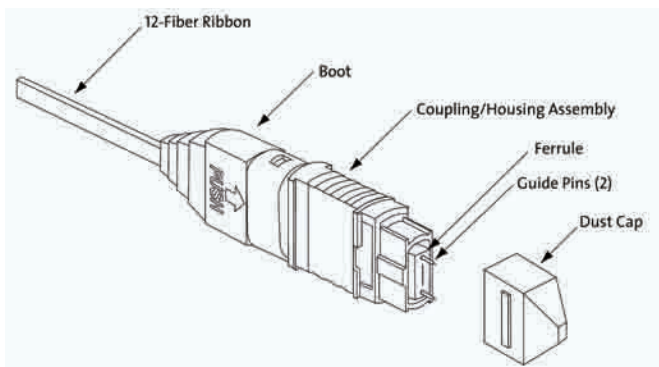


Figure 3: Ribbon Cable

Ribbon Optical Cable Termination

For many years, designers and installers have been reluctant to specify ribbon optical cable in the LAN and datacenter because 12-fiber ribbon field terminations were limited. With the introduction of innovations such as ribbon splitting tools, ribbon furcation kits and field-installable 12-fiber array connectors, 12-fiber ribbons are easily terminated with simplex and duplex connectors such as LC or SC connectors or with the MTP® array connector. The MTP connector is a 12-fiber push/pull optical connector with a footprint similar to the SC simplex connector. These high-density connectors are used to significantly accelerate the network cabling process, minimize errors and reduce congestion in patch panels. Today, the MTP connector is commonly available in preterminated form; either in pigtail form to be spliced onto a 12-fiber ribbon, or as an MTP connector backbone assembly which is terminated on each end. Field-installable MTP connectors are also available with the no-epoxy, no-polish design feature that allows termination of 12 fibers in less than 5 minutes. The MTP connector is specified to conform to the TIA/EIA-604-5 intermatability standard. See Figure 4.

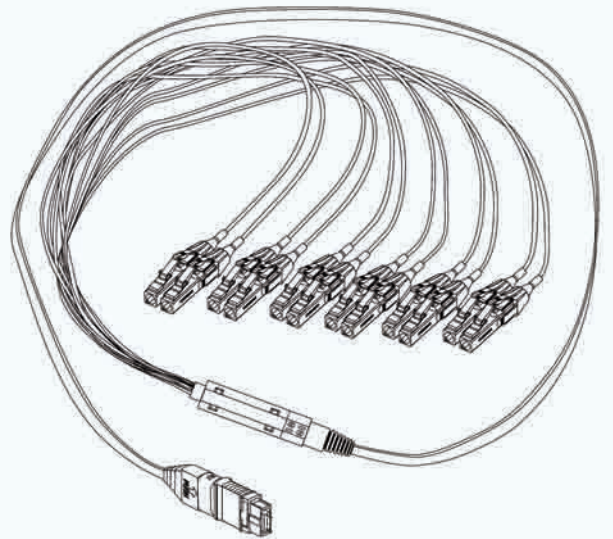


Figure 4: MTP Connector

Many end-users are now using preterminated cables where the cable is factory terminated with MTP and/or simplex or duplex connectors to ensure the highest quality connector insertion loss and return loss performance and to expedite the cable installation. This is especially apparent in the datacenter environment where short cycle installations and limited time availability for moves, adds and changes make simplified and fast installations critical.

The MTP connectorized ribbon cable is typically terminated in patch panels using two methods. Method 1 is normally used in an interconnect application where a harness assembly is used on the front of the patch panel. Harness assemblies are used to break out the 12-fiber MTP connectors terminated on ribbon cables into simplex or duplex style connectors. Harness assemblies have MTP connectors on one end of the cable while the other end is equipped with simplex or duplex style connectors. The harness assembly interconnects with the backbone ribbon cable at the patch panel MTP connector adapter. See Figure 5.

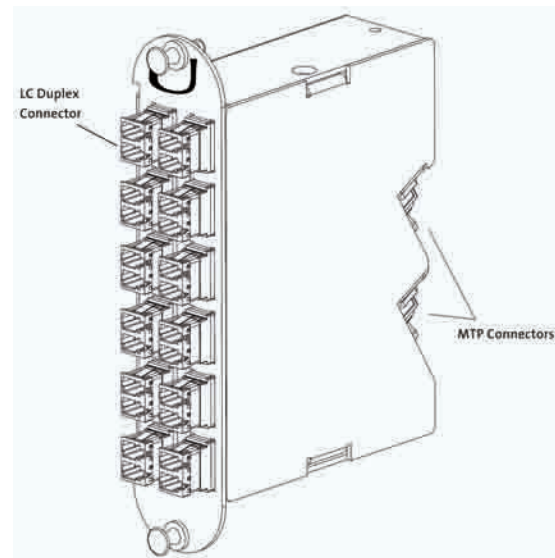


Figure 5: MTP Connector Harness Assembly

Method 2 is used in both interconnect and cross-connect applications where an MTP connector module is used. MTP connector modules are used to break out the 12-fiber MTP connectors terminated on a ribbon cable into simplex or duplex style connectors. Simplex and duplex style jumper patch cords then can be used to patch into system equipment ports, patch panels or client outlets. The module features simplex or duplex port adapters across the front and one or two MTP connector adapters across the back. Fiber polarity is maintained with an integrated wiring scheme built into the module that ensures proper transmitter-to-receiver continuity throughout the system so when end equipment patch cords are installed, transmit goes to receive. See Figure 6.

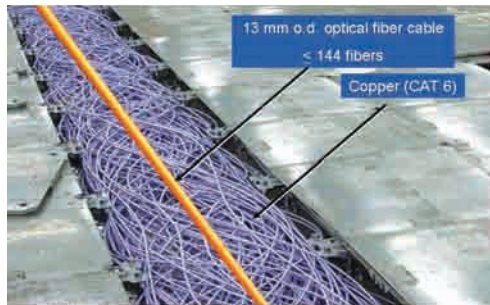


Figure 6: MTP Connector Module

Pathway and Spaces

It is critical to maximize utilization of pathway and spaces, especially in campus and datacenter backbones where space is a premium. Ribbon cables offer up to 45 percent space savings and three times the fiber tray capacity over traditional bulkier cable solutions while minimizing cable tray weight. Optimal cabled fiber density in datacenter pathway and spaces is important to facilitate efficient cooling systems as well as removal of abandoned cable in accordance with the National Electrical Code. See Figures 7 and 8.



Figures 7 and 8: Typical Datacenter Pathways

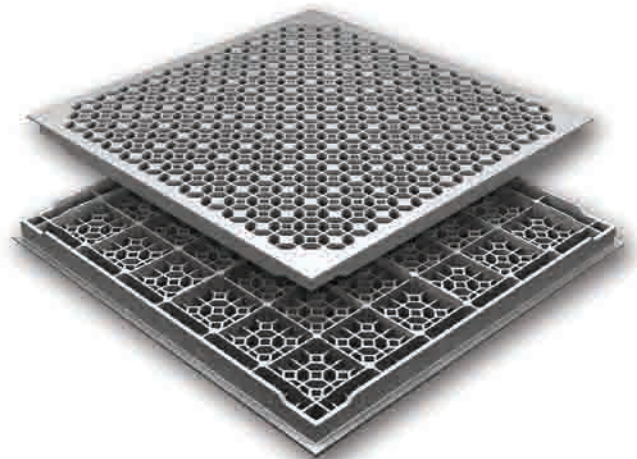
Summary

Ribbon optical cable is now being deployed in areas where stranded loose tube and tight-buffered cable have historically been used. The cable offers the highest fiber packing density to maximize pathway and space utilization in ducts and raceways as well as patch panels. Preterminated or field-terminated ribbon cable is now easily obtained using traditional simplex or duplex connectors as well as the MTP array connectors.

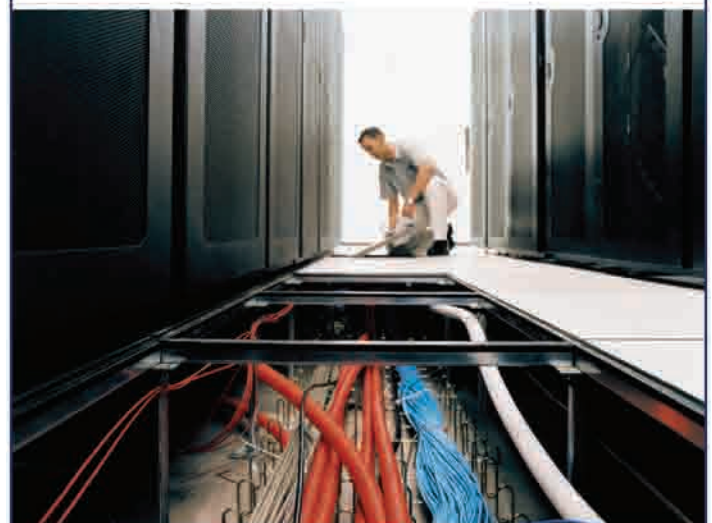
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by Harold Feinleib

Over 40 years ago, the advent of datacenters offered organizations the potential of greater reliability, security and connectivity, as well as access to a broader base of revenue-generating opportunities. However, the large mainframe computers that filled rooms and were accessed mostly in batch mode or at best by a small number of users through teletypes were eventually replaced by a more distributed architecture. The onset of these new and less costly technologies gave rise to a vast number of new applications, which in turn intensified the IT organization's challenges with additional complexity and continual change.

As we enter a new era of high-density computing, the increased state of complexity surrounding business operations has caused organizations to realize the critical need to run the physical infrastructure of the datacenter at higher levels of effectiveness and efficiency. As such, there has been an increased focus to improve datacenter practices. More and more organizations are recognizing their operational practices and processes within the datacenter are lacking and many are taking the appropriate measures to improve their level of datacenter operational maturity.

As recently as 2002, the vast majority of companies struggled with the management of their datacenters due to a variety of issues, including the use of home-grown, ad hoc processes; lack of documentation; lack of an organization-wide knowledge base; lack of standardized practices; unlimited access to datacenter by virtually any employee or vendor; and the absence of change management processes.

By 2005, new sets of best practices started to take hold. As companies have witnessed the increase in the rate of technological change, business complexities as well as compliance regulations, they have also experienced the critical need to provide better support and higher levels of availability. In addition, organizations, including 7x24 and the UpTime Institute, have dedicated themselves to assist companies in the creation and operation of knowledge communities to improve uptime management in the areas of datacenter facilities and Information Technology.

Even with this focus only a handful of organizations can be held up as best-practice examples for their vision in changing the way datacenters operate. These companies run their datacenter with strict discipline, control and manageability as well as the dedication to mitigate operational risks. Overall, these flagship enterprises operate the datacenter with people, processes and technology working in synchronicity to better deliver services to their organization.

Best Practices in the Datacenter

Research compiled by Aperture over the past three years has indicated a small percentage of organizations run their datacenters exceedingly well, with close to true end-to-end reliability. Through more in-depth investigations, Aperture identified the key factors that determine the processes and practices that these organizations conduct which differentiate them from most other datacenters.

Physical Order

The physical order of the datacenter comprises a variety of different aspects – from the layout and storage of devices, the policies and procedures established for the datacenter to the access controls put in place. The organizations with the best run datacenter facilities ensure the physical order of the datacenter is always maintained and organized. Every device and component within the datacenter is labeled to inform datacenter personnel of the aspects that may impact any necessary change (including servers, racks, tables, breakers, under-floor receptacles, PDUs, RPPs, cages, floor grid among others). In addition, no extraneous inventory or partially installed components are ever found in the datacenter.

Datacenter policies and procedures for these world-class organizations are detailed and easily accessible by all personnel. Every staff member is trained and tested in their understanding of the policies and procedures. One of the most critical components includes the access controls within the datacenter. Only a few staff members are authorized to enter the datacenter without prior approval. In one case study, a company who was



determined to transform their datacenter into a world-class operation recognized that this one variable could be the difference between an average datacenter and one that could provide true end-to-end reliability. As such, the company decreased the number of people with access into the datacenter from 200 down to eighteen. With this access control practice in place, the company was able to significantly improve processes and reduce the chance or errors within the datacenter.

Documentation

Documentation about the datacenter configuration is a vital element to build a true end-to-end reliable datacenter. It is used not only to identify how the physical infrastructure is connected (racks, servers, patch panels, switches, routers, power and network connectivity, etc.), track changes, run status reports, but it also is essential in the planning process. Only accurate and up-to-date information can be utilized in order to decide how changes are made and allow datacenter management to understand the potential impacts of a change prior to execution. For example, when a new 10-blade chassis is considered for the datacenter, the unified and easily accessible documentation will assist datacenter personnel in immediately knowing where there is enough space, power, cooling and network capacity, without the possibility of running into errors and potential downtime issues.

Change Process

As common sense would predict, the best-run datacenters have established a strong change process. Changes are always executed based on a specific plan, then performed in an organized and coordinated manner and verified once completed. All groups (including IT Engineering – Platform, Network and Storage, Datacenter Facilities and the Change Management team) work together to plan the change and communicate through a system that documented the change. In the planning stage, all impacts of the change are evaluated before a change is ever implemented. From this process, all dependencies are easily understood, documented and reviewed on a continual basis.

Metrics

Metrics provide the basis of intelligence within the datacenter – defined specifically as “the ability to apply knowledge to manipulate one’s environment.” These metrics – delivered in a clear, contextually relevant manner – enable senior executives to evaluate how to proactively manage the business and make strategic business decisions by deploying resources to deliver services efficiently and reliably. By producing and trending information, such as how many issues occurred in the datacenter, how much floor space, rack space, power capacity do we have and how many installs, decommissions and moves occurred, on a monthly basis, allow datacenter management to proactively plan for growth and demand in a reliable way.

Auditing

As more compliance issues and government regulations surface, the auditing of every component of the business has become even more crucial. By regularly performing audits of the datacenter, management has the capability to verify that documentation is accurate, processes are followed and devices are tested for redundancy issues. In addition, only through an

in-depth audit process can management identify areas and processes that may need refining to respond more proactively in the future.

Leadership and Organization

As stated previously, the datacenter is an integral part of an organization’s overall business strategy. When the leaders of an organization understand this basic premise, the datacenter can be utilized not only to reduce the costs of processing transactions, but also to assist in generating new business. Only through the use of best cost investments – those costs that provide optimal results – can a datacenter provide true end-to-end reliability without any downtime affecting employees or actual business operations.

Components of a Datacenter Management System

Research we have conducted the past three years has crystallized our vision for the definition of the components required in a datacenter management system that enables end-to-end reliability. Each of these components – Datacenter Portal and Repository, Change Process, Datacenter Monitoring, Information Delivery, Capacity Management and Auditing and Preventive Maintenance – assist in providing the best practice process and standards defined previously.

Datacenter Portal and Repository

The Datacenter Portal and its Repository is the centralized hub of where all information regarding the datacenter is stored and obtained. It holds a system of record about the entire physical infrastructure of the datacenter, including equipment, space, power, environmental, network and storage. The physical infrastructure system of record is then integrated with information from a variety of other IT systems of record in order to provide a comprehensive and cohesive view of all information required to run the datacenter effectively and reliably.

Datacenter Change Process

The Datacenter Change Process – managed through the Datacenter Portal – is used whenever a change is needed. All such changes reflect the standardized policies and procedures and workflow process defined for the datacenter. Each change is planned by using the repository data, such that the impact of the change would be understood before implemented. Business rules are also used to determine how a change should be performed, ultimately creating the specifications for a particular change. By establishing such a rigorous change process, an organization minimizes the potential of human error and downtime.

Datacenter Monitoring

When an organization has multiple datacenters in various locations, the Datacenter Monitoring component provides a view of all datacenters and shows any alerts associated with a particular datacenter. This system is integrated with all other systems give a unified view of all physical infrastructure devices and display alerts as they occur. The monitoring component provides the real-time data required to automatically adjust the environmental and to maintain an optimal environment.

Information Delivery

Intelligence in the form of actionable information must be disseminated to key people upon certain conditions. The Information Delivery component generates a complete set of datacenter metrics that provides visibility into the datacenter capacities as well as any additional information that impacts resources (i.e., inventory counts, number of changes being performed over time, adherence to SLAs, business process, bottlenecks, workloads of staff and information tied to the external world.

Capacity Management

Capacity measurements assist in delivering key performance indicators that track past usage and forecast future demands. Only through these measurements can resources and funds be allocated appropriately. In addition, the latest trend of proactive virtual modeling takes forecasting to a deeper level by helping organizations plan for the technology refreshes required for a particular datacenter environment.

Auditing and Preventive Maintenance

The Auditing and Preventive Maintenance component helps ensure accuracy of information as well as provide the capabilities for continuous improvement. All devices are tracked through a bar-coded or RFID tags. Processes are run against the datacenter repository to ensure consistency and scheduled maintenance functions are automatically performed.

The Need for End-to-End Reliability

In today's complex business environment and unprecedented rate of technological change, it has become essential to provide end-to-end reliability within the datacenter. To best achieve such levels of reliability and ultimately process maturity, organizations must solve a number of pressing issues:

1. Most are not operating at the level required to provide true end-to-end reliability at this point in time.
2. Demands on the datacenter are increasing dramatically and a plan to accommodate these demands is critical to survive.
3. IT and Datacenter Facilities must work as a team.
4. Putting best practice and automated processes in place are critical factors to manage the increasing complexities within the datacenter both today and in the future.
5. Meaningful information must be delivered upwards.

The ultimate objective for any datacenter manager is to provide a highly reliable datacenter that meets the growing needs of the organization. In order to accomplish this difficult task, it is critical to know exactly what exists in the datacenter and establish an orderly change process that insures changes are made to provide the reliability needed. This can only be done when the information upon which these decisions are made is 99.99 percent correct.

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WILL LIQUID COOLING SOLUTIONS SAVE ENERGY?

by Vali Sorell and Terry Rodgers

Recent technology advancements by IT equipment manufacturers have resulted in high heat producing hardware that pushes the envelope of traditional air cooling methodologies. In response, various infrastructure vendors have introduced “liquid-cooled” solutions as viable alternative that can accommodate as much as 30 KW-per-rack or more. This article will discuss the energy efficiencies of the various cooling solutions available today and some possible cooling solutions that may be introduced in the near future.

First, with the exception of some uncommon specialized hardware systems (and surprising to many, laptops), there are for practical purposes, no “liquid-cooled” hardware used in commercial datacenters today. The definition of liquid-cooled hardware is where the primary heat transfer medium inside the hardware itself is a liquid that exists internally within the electronics. Some super-computers and old legacy mainframes employ liquids that are piped directly into the hardware to cool the heat generating electronics. There are also some specialized military electronic packages that use evaporative spray-cooling

technologies and some computer game manufacturers that utilize true liquid cooling designs.

The “liquid-cooling” solutions hitting today’s market still require air-to-liquid heat exchangers that provide air cooling at the individual rack where the electronic equipment is housed. The IT hardware chassis still includes integral fans to move the cool air through the inside of the hardware chassis to move the heat from the electronics to the air within the cabinet (or rack). Technically, this is still air cooled hardware.

For the sake of comparison, we first need to define the cooling scenarios typical of today’s Datacom facilities, and some baseline assumptions and limitations associated with this analysis. Our goal is to focus on what (if any) energy savings can be attained associated with the various options available. Obviously, different geographic locations will have different outside environmental conditions that can affect the potential efficiencies of heat rejection to atmosphere. For instance, air-cooled chiller, dry-cooler, and cooling tower efficiencies are affected by the outdoor ambient conditions. Some locations

afford the potential (at least during certain seasonal periods) for employing air or water-side economizers. These parameters will be normalized to allow a better comparison of the different scenarios that exist within the datacenter proper.

We have reduced the myriad of cooling technologies available to five distinct scenarios, and then added three additional scenarios that may become available in the future. These scenarios will each be analyzed individually to quantify what energy efficiencies (or inefficiencies) are inherent for each. The scenarios are:

1. Conventional Computer Room Air Conditioners (CRACs)
2. Rear Door-Mounted Cabinet Cooler
3. Compressor-less Liquid-Cooled Cabinet
4. Water-Cooled Cabinet
5. Conventional Air Handling Units
6. Water-Cooled IT Hardware with Chillers (Future)
7. Liquid-Cooled Hardware with Chillers (Future)
8. Liquid-Cooled Hardware without Chillers (Future)

It should be noted that parallel heat flow/rejection paths (e.g. some heat to pumped liquid, some to room) where a mixture of the above scenarios are employed are not considered within the context of this comparison.

Each scenario will begin at the heat source (i.e., the IT hardware) and end with the heat being rejected to the outside ambient environment (i.e., to atmosphere). Each will breakdown the heat transfer path to incremental steps to include the medium (water, air, refrigerant, etc), the prime mover (fan, pump, compressor, etc), and the heat transfer component (heat exchanger, fluid-cooler, chiller, cooling tower, etc.). Then, the total system energy efficiency is estimated for each scenario. Also for the sake of comparison, each scenario assumes the

hypothetical facility employs recognized best practices such as minimized bypass air, balanced air and/or water distribution, and equipment properly maintained and operated per the manufacturer's recommendations.

Figure 1 below provides a schematic representation of the eight scenarios analyzed. The energy calculations are based on assumptions and/or "givens" for a representative facility of 1 MW equipment input and cooling equipment selected according to current best practices to handle that total quantity of heat rejection:

1. 1 megawatt (MW) of IT equipment input corresponds to approx. 285 tons of cooling.
2. For Air Handling Unit (AHU) systems assume a 20 degree F temperature delta with 25% extra air to account for leakage, stratification, etc (approx. 196,000 cfm total).
3. For Liquid-Cooled Cabinet systems assume 20 degree F temperature delta with no leakage (approx. 157,000 cfm total).
4. For pumping systems with water as the medium, the specific gravity is assumed to be 1. For pumping systems with refrigerant as the medium, the specific gravity varies between 1.3 to 3.4, depending on which refrigerant is used.
5. For AHU systems, the fan efficiency is assumed to be 85% for 40,000 CFM fans at 0.3" external static. For CRAC unit fans, the fan efficiency is assumed to be 70% at 16,000 CFM; the pressure drop is assumed to be 0.3". For cabinet fans, the fan efficiency is assumed to be 40%; the pressure drop is assumed to be 0.3". Cooling tower fans are assumed to be 75% efficient at 0.3" static pressure.
6. Chilled water piping systems are assumed to be designed at 12 degrees F delta T. Condenser water systems are assumed to be sized for 3 gpm/ton.

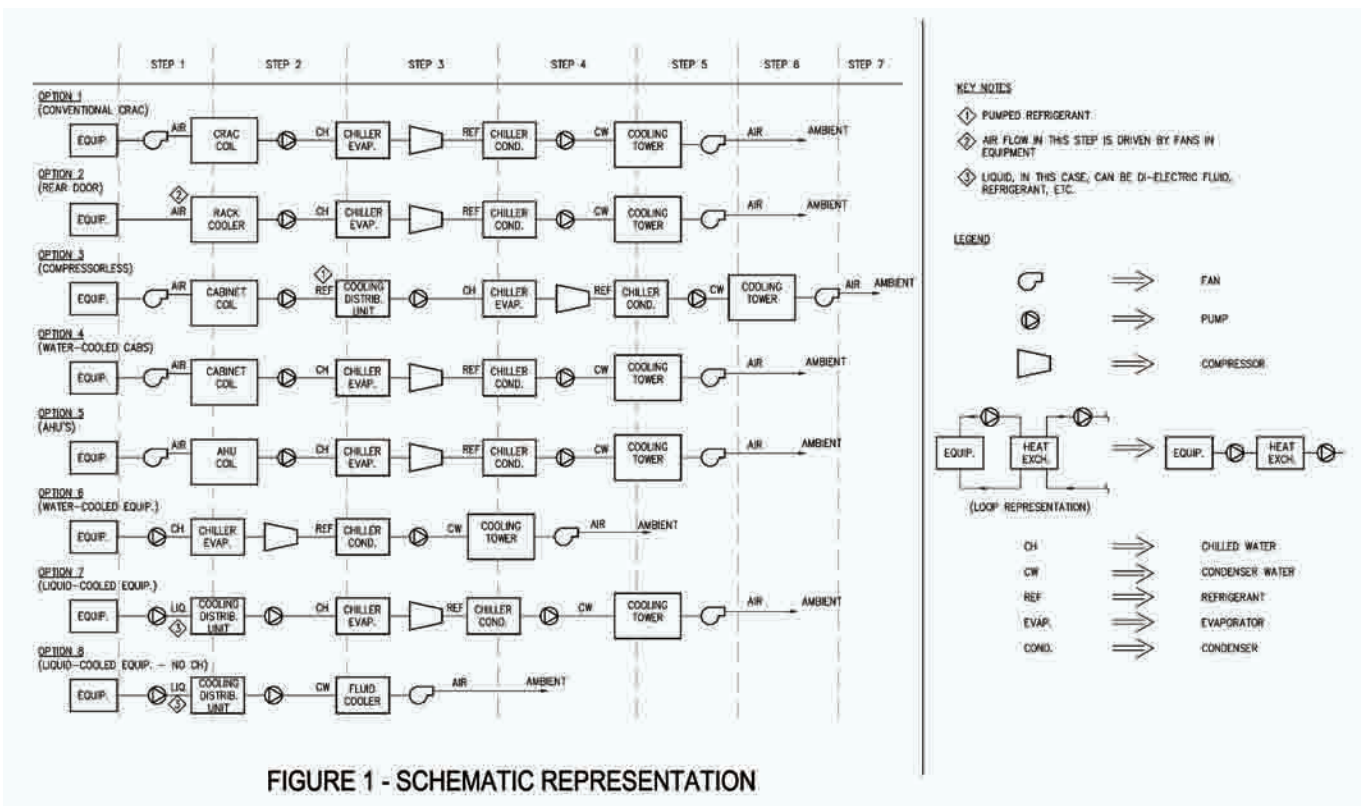


FIGURE 1 - SCHEMATIC REPRESENTATION



7. Large pumps – i.e. serving condenser or chilled water systems, are assumed to be 75% efficient. Small pumps, such as serving cooling distribution units and/or individual cabinets circuits, are assumed to be 50% efficient.
8. Typical pump heads are 75 – 125 feet for chilled water systems and 40 feet for condenser water systems. For piping between heat exchangers and/or CDU's, assume 50 feet of head.
9. Compressors for water-cooled chillers are assumed to be selected between 0.45 – 0.55 KW/ton.
10. Air-cooled chillers and compressorized CRAC unit systems are not considered. Each has analogous systems that are considered below that have superior performance. Since the goal of this exercise is to identify which system can be more efficient, considering the systems that are clearly less efficient is not necessary.
11. Energy usage is normalized to 1 MW of input at the IT equipment

Scenario #1 – Conventional Computer Room Air Conditioners (CRACs)

IT Hardware chassis fans move the generated heat from the hardware chassis through the cabinet to the ambient room environment. CRAC fans pull the air across the cooling coil (heat exchanger), which absorbs the heat into a central chilled water system. The chilled water is pumped back to a chiller plant, which transfers the heat via a compressorized refrigerant cycle to either the outside environment directly (air-cooled chiller) or to a condenser-water system (water-cooled chiller). In the case of a water-cooled chiller, a pump moves the condenser water to a cooling tower (water-to-air heat exchanger), which rejects the heat to the outside environment. (Air-cooled chillers are not considered here.)

Scenario #2 – Rear Door-Mounted Cabinet Cooler

IT Hardware chassis fans move the generated heat from the hardware chassis through a cabinet rear door-mounted cooling coil (air-to-liquid heat exchanger). Note that this scenario uses the IT hardware chassis fans to move the heat through the rear door-mounted cooler. Ideally, the air leaving the cabinet cooling coil is at ambient room conditions. The heat absorbed by the liquid in the cooling coil is pumped back to the central chiller plant where the remainder of the heat transfer methodology matches that described above in Scenario #1.

Scenario #3 – Compressor-less Liquid-Cooled Cabinet

IT Hardware chassis fans move the generated heat from the hardware chassis. A cabinet mounted fan moves the heated air across a cabinet-mounted cooling coil that utilizes a refrigerant (air-to-liquid heat exchanger). The refrigerant leaving the coil can be either liquid or gas. The refrigerant is then cooled by a Cooling Distribution Unit (that can support more than a single cabinet). The refrigerant leaves the Cooling Distribution Unit as a liquid where it is pumped back to the cabinets. The Cooling Distribution Unit incorporates a refrigerant-to-water heat exchanger. The water is typically chilled water and then pumped back to a central cooling plant and again proceeds as described in Scenario #1 above.

Scenario #4 – Water-Cooled Cabinet

IT Hardware chassis fans move the generated heat from the hardware chassis to the air contained within a sealed cabinet. The sealed cabinet includes an integral fan-coil typically located in the bottom of the cabinet. The air within the cabinet is continuously recycled through the cabinet and the heat rejected from the IT hardware is absorbed by the integral fan-coil. Note that this scenario uses the IT hardware chassis fans to move the heat to the cabinet air and the cabinet fan-coil moves the cabinet air across the cooling coil. Ideally there is no air leaving the cabinet to the room ambient environment. The heat absorbed by the liquid in the cabinet fan-coil is pumped back to the central chiller plant where the remainder of the heat transfer methodology matches that described above in Scenario #1.

Scenario #5 – Conventional Air Handling Units

This scenario is essentially the same as that described in Scenario #1 except that fewer, larger Air Handling Units replace the smaller CRACs.

The remaining three scenarios depict true water-cooled IT hardware that essentially does not currently exist in the commercial Datacom repertoire. It is quite possible that as IT equipment heat densities continue to climb, IT manufacturers may soon introduce new product lines that incorporate actual liquid mediums in direct contact with the electronics to remove the heat from within the chassis to a point outside the equipment where the “facilities utilities” can transport the heat to the outside atmosphere. Currently, ASHRAE’s Technical Committee TC9.9, Mission Critical Facilities, Technology Spaces, and Electronic Equipment, is preparing a 4th book in the “ASHRAE Datacom Series” that will address the facilities’ interface to existing liquid-cooled cabinets and to some extent, possible liquid-cooled IT equipment of the future. This book, tentatively titled “Liquid Cooling Design Considerations for Data and Communications Equipment Centers”, is slated for publication as early as the summer of 2006.

Scenario #6 – Water-Cooled IT Hardware with Chillers (Future)

This scenario assumes introduction of IT hardware that employs a water-cooled heat sink (possible a cold-plate) that “utility” water is piped directly to. Note that there would be no chassis fans or cabinet fans and the IT hardware would be liquid-cooled by standard central plant Chilled Water.

Scenario #7 – Liquid-Cooled Hardware with Chillers (Future)

This scenario is similar to Scenario #6 except that the IT hardware would incorporate a liquid medium pump within the chassis and an associated pump to move the heat to a separate Cooling Distribution Unit. The Cooling Distribution Unit could support one or more liquid-cooled IT components and is essentially a liquid-to-water heat exchanger. Chilled water from the Central Cooling Plant would cool the Cooling Distribution Unit and the remainder of the heat transfer process again matches that described in Scenario #1.

Scenario #8 – Liquid-Cooled Hardware without Chillers (Future)

This final scenario is similar to Scenario #7 but eliminates the need for the Central Cooling Plant and assumes the Cooling Distribution Unit is cooled by water (or water-glycol mix), which is pumped outside to a Fluid-Cooler where fans reject the heat directly to the outside atmosphere.

Table 1 below tabulates the energy calculations for each scenario and summarizes the total energy efficiency for each.

Some general conclusions can be drawn from this analysis, as follows:

- In general, the fewer “steps” employed to move the heat from the heat generating source (IT equipment) to the outside atmosphere, the less energy required and therefore the better the overall energy efficiency attained. One notable exception is the recognized inherent loss of efficiency of air-cooled chillers compared to water-cooled chillers in conjunction with cooling towers.
- Fewer, larger components within any particular “step” are typically more efficient than a greater quantity of smaller components providing the same function.
- The specific gravity of the liquid transport medium also plays an important role in the amount of energy consumed within each step. According to the fan equation:
- Brake horsepower = GPM x head (in feet) x specific gravity / (6350 x fan efficiency)

It is clear that as specific gravity increases, the input power required to move the fluid increases proportionately. Water (specific gravity = 1) is a good transport medium. Refrigerants (specific gravity range of 1.3 to 3.4) is not as efficient a medium. Dielectric liquids (such as Fluorinert, specific gravity of 1.9) is not as good as water but is better than some refrigerants.

Some specific conclusions can be drawn from this analysis, as follows:

- AHU systems are inherently more efficient than CRAC systems because of the higher efficiency of the fans.
- Compressorless liquid-cooled cabinets are somewhat inefficient due in part to the larger number of heat transfer

steps, and in part to the use of a refrigerant transport medium.

- Water-cooled cabinets are less efficient than conventional CRAC unit or AHU systems, and were the least efficient of the scenarios considered.
- A rear-door cooler can be as efficient (or even slightly more efficient) compared to an AHU system.
- Liquid and water-cooled equipment (of which none are yet commercially available) are not expected to be significantly more energy efficient than the other relatively efficient and available systems (i.e. AHU or rear-door coolers). However, due to other significant advantages, mainly that much higher load densities are achievable, these liquid and water-cooled equipment may still be found to be very desirable.
- Liquid-cooled equipment without a chiller plant (also not yet commercially available but technically very feasible) can offer significant energy savings compared to all other options. In addition, because of the system’s simplicity, it would be expected that this type of system would be easier to maintain and significantly more reliable than the other scenarios.

KW demand in to the equipment will always balance with the energy out in the form of heat. The analysis undertaken in this article relates strictly with the energy expenditure associated with transporting that heat from the IT equipment to the ambient surrounding the facility. Obviously, some scenarios for transferring this heat are more energy efficient than others, and these need to be considered as part of the Total Cost of Ownership of the enterprise and associated physical facility. Other issues relating to equipment reliability, maintainability, and especially the issues relating to the IT equipment configurations as they relate to the core function of the facility, must be considered completely before any decision is made in selecting the most appropriate cooling system for a datacenter facility.

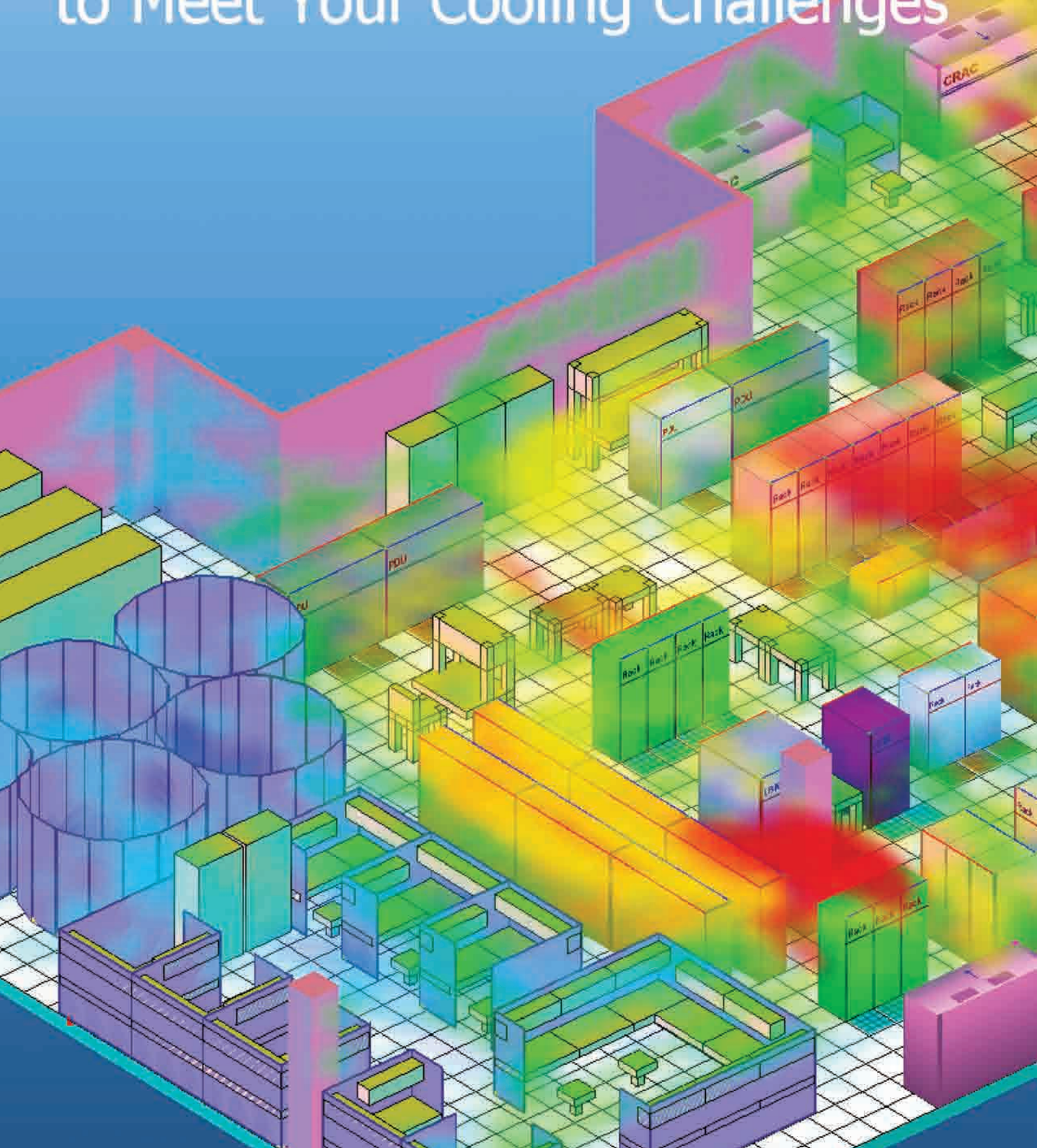
Herbert (Vali) Sorell and Terry Rodgers are Senior Associates of Syska Hennessy Group, Inc. They can be reached at vsorell@syska.com or trodgers@syska.com

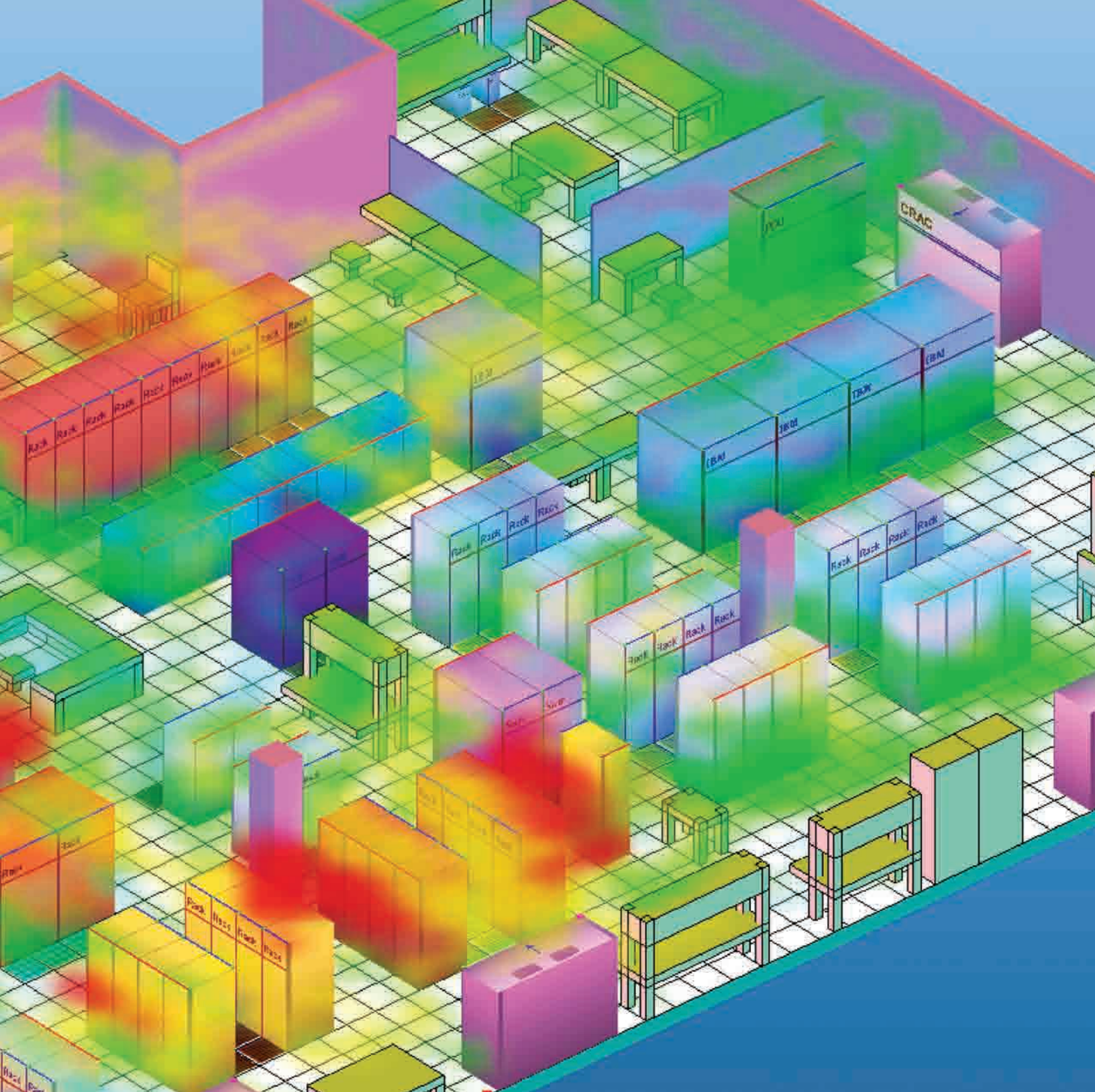
TABLE 1: HVAC KW INPUT / 1000 KW OF IT EQUIPMENT

Option	Step # (Reference Figure 1)						Total
	1	2	3	4	5	6	
1 – Conventional CRAC Units	12.5	16.0	145.0	10.0	4.5	–	188.0
2 – Rear Door Cooler	–	17.0	145.0	10.0	4.5	–	176.5
3 – Compressorless	20.5	4.0	8.0	145.0	10.0	4.5	192.0
4 – Water-Cooled Cabinet	21.0	17.0	145.0	10.0	4.5	–	197.5
5 – Air Handling Units	9.0	16.0	145.0	10.0	4.5	–	184.5
6 – Water-Cooled Equipment	16.0	145.0	10.0	4.5	–	–	175.5
7 – Liquid-Cooled Equipment	15.0	16.0	145.0	10.0	4.5	–	190.5
8 – Liquid-Cooled Equipment (no chiller)	15.0	10.0	4.5	–	–	–	29.5

Note: All KW input numbers above represent the midpoints of ranges representative of variations in equipment, design, and implementation.

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IF IT AIN'T BROKE, FIX IT

The Value of Maintenance to Mission Critical Systems

by Douglas H. Sandberg

I'm quite certain that anyone reading this recognizes the title play on an old axiom. With the tremendous financial impact and the risk of personal liability, many of those responsible for mission critical operations are rethinking their maintenance program. This paper focuses on maintenance and its effect on the life cycle of the engine generator / turbine and switching aspect of the emergency power system. However, maintenance is not the only factor, which effects equipment life cycle.

What is the life cycle of a given piece of equipment or a system? It could be simply expressed as the period of time beginning at installation and ending when it is no longer usable. I would submit to the reader that the useful life of a piece of equipment may be significantly lengthened (or shortened) by a cycle of events revolving around maintenance. All of the elements set forth in this brief article directly effect the condition of the equipment, maintainability, reliability and finally useful life.

The factors, which determine the length of the usable life of any piece of gear, begin to occur long before installation.

Proper Design & Application

All too often some aspect of this is lacking. It may be physical restrictions, which prevent proper maintenance, the application, and the type of equipment selected. As Automatic Transfer Switches go there are specific technologies for specific applications. The major types supplied by most manufactures are as follow.

- Standard break before make with no service bypass. Application is limited to non-critical application. The break, which occurs in transition from the "normal" source to the "emergency" source while very brief, may effect other system elements.
- Standard break before make with service bypass. Basically 2 switches (one automatic, one manual) in parallel. The manual switch is used to bypass the automatic for maintenance or replacement of the automatic unit.
- Standard make before break or closed transition with or without service bypass.
- Delayed transition. Stops in mid position to allow for the decay of large inductive loads thereby limiting inrush.
- Softload is basically a closed transition ATS with a synchronizer and power controller. Used to "walk" the load from one source to the other. Especially useful where the standby source size is marginal or soft like natural gas or methane plants.

For example, closed transition is best for feeding a UPS. While the initial power outage transition to the emergency source of power operates the same a standard break before make ATS.

- When power fails, the ATS controls initiate a signal to start the standby generator.
- After the emergency generator starts, the ATS controls sample the power to insure it is the proper voltage and frequency.
- The ATS controls initiate a transfer to the emergency source.
- After the event, a seamless transfer back to the normal source prevents the UPS from hitting the battery again.
- Should the owner decide to place the facility on standby power, a seamless transition to and from the alternate source is possible while a dual hit to the battery is prevented.
- Should the UPS be in the bypass mode, a no break transition prevents loss of load.
- If the ATS is equipped with isolation / bypass feature, the ATS mechanism and controls may be serviced without effect to critical loads.

Having decided what type is best suited for the system demands; one must consider how the individual ATS will interface with the engine controls.

- How will priority load shed be handled & are the ATSs associated with the system equipped with the proper controls.
- Are the governors and voltage regulators of the proper type to interact with the UPS for example?
- What about communications and monitoring.

Careful Handling & Installation

Here again events occur which can severely effect the useful life of a piece of equipment.

- Did it ship well? Only incoming inspection can tell. Inspection should take place obviously before you accept the gear.
- Store the gear in a dry, safe environment. Moisture or condensation can and will degrade insulators or stand-offs. Moisture also attracts dust and dirt, which may become conductive.
- Those who are charged with installing the gear should be thoroughly familiar with the manufacturer's recommendations. Extreme caution must be observed not to let metal shavings or other debris contaminate the unit or controls.

- Personnel should read the installation and operations manual. Do not force controls or the mechanism. If you're not sure what to do, call the manufacturer for guidance.
- Remove all shipping blocks, bolts etc.

Benchmark Testing

This aspect cannot be emphasized enough. The manufacturer should be contacted to participate in the planning of the benchmark or initial commissioning test. This may well be part of the purchase package, however if it is not, a few dollars invested at this point may save a few thousand later.

- The owner or designer must participate in this task. You must insure that all programmable set points and time delays are understood, properly set and indeed function.
- Test the individual gear as a unit and follow with a system level test. Too often gear works fine by itself but fails to work properly a system. A good example is if the low voltage set point on the ATS is set lower than the same set point on the UPS. A brown out may cause the UPS to go to battery while the ATS remains on a low utility and will not start the engine nor transfer to the alternate source. This condition would result in battery depletion and loss of load
- Are the time delays adjusted properly? Overriding short outages is very important. Again, this feature should match the UPS settings to prevent unnecessary hits to the battery.
- Insure that load priority blocks are properly assigned. This prevents the generator bus from being overloaded while ensuring that critical loads are maintained.
- Document and retain all setpoints and adjustments on each piece of gear.

Document Control

Each piece of gear has documentation. The system also has documentation associated with it. This body of information includes operator's manual, bills of material, one line schematic diagrams, detailed control and power schematics, mechanical details etc.

Maintaining this information is paramount. It is your only reference in an emergency. Control settings as detailed in the section on testing are also part of the record.

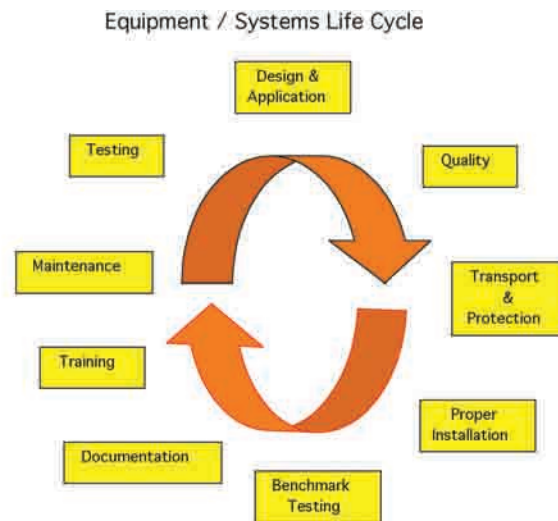
A master one line on the wall under glass or plastic and adjacent to shitchgear is a quick reference point in an emergency or when operating the system.

Training

The system survived shipment, installation is complete and testing has been done. Now it will be the province of the personnel who maintain and operate the site.

- The manufacturer should be contacted to determine what training is available.
- Aside from basic operation and automatic features, personnel must understand how to manually operate systems in the event of failure of the automatic features.
- Example: It's the middle of the night, the utility power has failed, the UPS is on battery, the engines have started but not paralleled to the bus. Site personnel must be able to assess the situation and manually synchronize the engine generators before the UPS battery is depleted.

Routine Preventive Maintenance



This is one of the most neglected aspects of the critical power system. In this context, neglected can mean that maintenance is simply not done a routine basis, may not be able to be done properly due to improper physical or electrical design or simply because the owner does not understand the process.

Too often the decision made on the maintenance provider or type of program is made strictly on price. The problem is that all programs are not created equal.

In order to understand exactly what you'll be receiving

for your maintenance dollar you have to ask some probing questions.

The following 10 questions will help you determine the value of the program.

- **How are your service technicians selected, trained and qualified to work on my critical equipment?** This is important. Some maintenance companies have only a few specialists. While they may have many people, the person arriving at your site in an emergency may not be skilled or trained to effect the repair.
- **How many folks do have on staff?** Are there enough folks to go around in the event of a disaster or heavy schedule?
- **Do you provide 24-hr. service? How? (Have them explain call handling, escalation and response procedures).** The owner must understand how people will be contacted and directed when you need them. A good escalation plan provides for uniform steps and involvement of escalating levels of management.
- **Is your company authorized and or trained by the manufacturer? Prove it.** No big deal right? Wrong. Your emergency power system is the lifeblood of the facility. The people working on it must have the proper skill set and training. Your life may literally depend on it. And let's not forget the personal liability you may have. Civil actions and penalties are becoming the law of the land, protect your facility and yourself.



- **Can your company provide training for my staff?** This is also important. Why? I'm not suggesting that your staff be trained to do the maintenance or repair on critical gear. I'm also not suggesting that they are incapable of learning how. I am suggesting that without constant exposure, they will not remain sharp. They should be taught how the equipment and system is expected to operate under normal and abnormal conditions. They should understand how to operate the system. In the case of a transfer switch for example, one must understand how to operate the bypass if so equipped or manually operate the ATS safely. The engine control system is equally important. The ability to manually start and parallel engines may mean a lot to your datacenter or hospital in the middle of the night.
- **How do you support the technicians who will be on my site? (Technical support, parts etc.)** What happens when the technician can't figure out the problem? Does the prospective service provider have help available 7 x 24?
- **How does your company become aware of product changes, technical bulletins etc. from the manufacturer?** This is normally limited to the manufacturer's own Service Company or authorized agents. You will want your provider to be aware of anything effecting your system. How well they are connected makes a huge difference.
- **What type of maintenance agreements do you offer?** Too often, the selection of a maintenance vendor is based on price alone. If you rely on a critical system to run your building or business, you must understand how it is being maintained. You must understand the type of agreements available. These range from simple inspection to factory recommended maintenance to full replacement. At some point cost is a factor but don't let it be the "only" factor.
- **What is the average experience of your field force on the equipment I have?** This is another important measure. There are many companies who have general knowledge. Make sure you understand this aspect.
- **What spare parts do you carry for my equipment?** You will find that many companies do not invest in spares. They may bank on the manufacturer having spares available in an emergency. The bottom line is that if you're in the maintenance business, spare parts are a cost of doing business. Will they have the parts you need in an emergency?

Maintenance is more important than ever. The dollars associated with critical operations are substantial, the maintenance window is shrinking or non-existent, in certain applications, life may literally depend on a properly operating system (should you find yourself in a hospital on life support you may want to think about that). In any case, the emphasis seems to be on the lowest possible dollar and very little is done to qualify the provider. Personal liability is becoming of concern. Some levels of staff are subject to civil or legal penalties should the system fail.

Medications & Upgrades

A viable option as systems age, technology changes. Advances in technology may mean that new flexibility or features are possible. It may also mean that some manufacturers consider some components obsolete.

The system requirements may also change. The message heard is that modifications & upgrades are viable options, which may be considered as an alternative to costly replacement.

Emergency power systems are subject to a unique dichotomy. They are a mixture of durable, robust components (Diesel, gas or natural gas engines, alternators, fuel tanks, mufflers, ATS switching mechanisms, circuit breakers etc. and the systems which control them. With advances in technology, it is the control systems, which are subject to great changes. There are two basic considerations.

1. New technology offers new more accurate, easier to user components.
2. Advances in technology also lead to obsolescence. As manufacturers look to the cutting edge, some components are replaced and become obsolete as far as the manufacturer is concerned. That's not good news if your system is built around those components. This is not to say that parts are suddenly unavailable. Usually manufacturers will maintain a stock of obsolete parts for a time in deference to their commitment to their customers but eventually stock runs out. This is especially true when dealing with microprocessors. So the point is to understand what you have and whether it is supported.

Some organizations specialize in modifications and upgrades to legacy systems. The cost to modify an emergency engine control system with new control panels & doors is roughly two-thirds the cost of replacement gear. To complete the cost analysis, you must consider the additional expenses associated with electrical disconnect & re-connection, rigging, mechanical work and disruption to the facility. You may also require rental equipment while you are replacing the gear. You will find that the cost of modifications is very small compared to replacement.

Testing

Periodic testing allows for system performance comparison to initial benchmark testing. Carefully performed and controlled tests may also indicate degradation in certain areas.

Conclusions

The conclusion is pretty simple. We began with the premise that equipment and systems have a life expectancy. System design in part will be judged on the useful life provided. A comprehensive maintenance program is much more than dusting off the equipment and hitting the test switch. There are many factors, which develop a cycle of events, which includes traditional maintenance, and will ultimately determine how long a system is viable. Therefore, this package of services or collection of events should be viewed in total and attention paid to all aspects of the cycle. Ultimately, attention to the cycle will yield continued reliable performance. Failure to do so will yield premature failures, which are preventable.

Alas, this all costs money but at the risk of employing another old cliché, Pay Me Now or Pay Me Later.

Douglas H. Sandberg is Director of Operations of ASCO Services Inc. He can be reached at dsandberg@ASCO.com

Working with the best has its advantages. (Starting with a good night's sleep.)

RELIABILITY



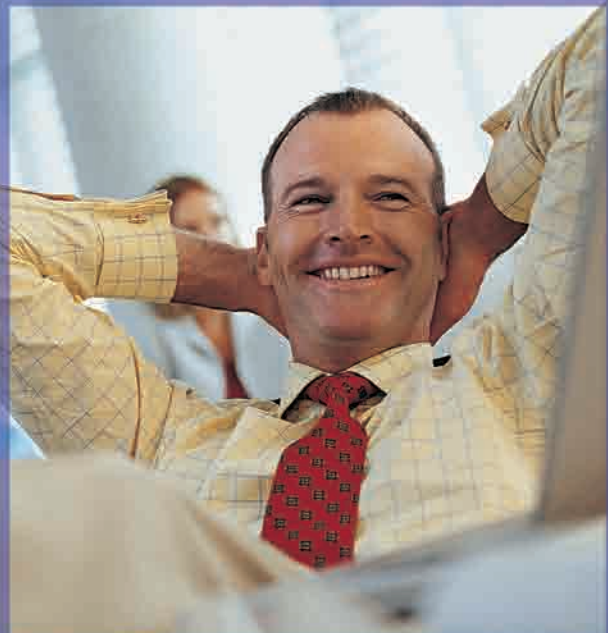
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Effectively Planning for Growth and Change in Datacenters

EQUIPMENT NEEDS AS A MAJOR CHALLENGE

by Johnny Hembree, AIA

Owners and operators of 7 X 24 datacenters have no small task in planning for growth and change in their equipment needs. This is because new equipment creates new power supply issues, which in turn significantly affect heating, ventilating, and air-conditioning (HVAC) designs.

Owners can effectively design their facilities to meet these needs – today and well into the future – by adopting one of several emerging design strategies. These include water-cooled equipment racks, natural gas vs. diesel generators with potential dual fuel sources, and improved battery efficiency / maintenance / racking for decreased building square footage.

Cooling Challenges and Solutions

Watt density in modern datacenters is 400 watts per square foot – a load that won't soon decrease. The increases are the result of smaller processors, which allow more equipment to be stacked

However, the technology that can support heat gains and increased watt densities creates another problem: water, a silent but very destructive foe for the datacenter environment. Given the potential damage that a water leak might cause, designers must answer serious engineering questions about leak detection, containment, and emergency procedures before they adopt this technology – but the problem is not insurmountable, as long as the solution is properly designed.

Another issue involves the end users' ability to manage the active data floor as they add, move, and change servers in the system, because inevitably, they will also need to add, move, and change racks. The industry must think through the procedures for making such changes in a water-cooled environment on a live data floor.

The aeronautics industry offers some direction toward solutions. The harsh environment of outer space requires



An innovator of internet banking technology, S1 Corporation required a state-of-the-art datacenter with on-site operations command. The facility includes 1,000-SF control center featuring three 100 inch rear projection screens and custom consoles in a raised access floor environment.



12,000-SF datacenter on a 12-inch raised floor with N+1 redundancy for cooling and electrical infrastructure.

*Norcross Technology Center, Norcross, Georgia
Photo Credits: John Grunke*

in datacenter racks. Modern blade servers, for example, fit into a 1U environment rather than the traditional 2U configuration used for older servers. While this makes it possible to double server capacities in existing footprints, a single blade server draws more watts per square foot, and puts out more heat per square foot, than the two traditional servers it replaced.

This apparent technological wonder single-handedly affects the center's power and subsequent cooling needs. A traditional hot-aisle, cold-aisle cooling strategy cannot match the increased heat with only increased cool airflow. To deal with the more intense cooling requirements, the industry has taken a cue from the water-cooled mainframe servers that characterized the 1970s and 1980s: engineers have designed water-cooled racks matched to contemporary server racks.

technology that ensures against fluid and air leaks during quick equipment connections and disconnections. Water-cooled datacenter racks could use similar connection technology. This would allow the end user to react to ever increasing business demands for adds, moves, and changes without fearing a liquid catastrophe.

However, if designers and industry experts cannot adapt systems to this new technology in a controlled environment, then they must rethink the existing cooling units relative to footprint and cooling tons available. The real reason for the raised floor is for servers, not infrastructure. So, as more units are added to raised-floor environments, more square footage is lost for rack/server placement.

Left unaddressed, this could lead to the demise of the mega-centers that corporations need. Their need for cooling systems that support continuing growth in watt density means that the building square footage devoted to infrastructure is surpassing that of the raised floor for server racks. Thus, at a time when investors are driven by profits and not shortfalls, the ultimate project cost cannot be dealt with in the basic pro-forma.

Natural Gas vs. Diesel Generation: can they work together?

Increasing datacenter power requirements also demand more powerful generator backup systems. In today's large facilities, end users have taken to installing 2-megawatt diesel backup generators rather than natural gas generators that cannot match such a megawatt output.

Diesel generators have their own inherent problems. Compared to natural gas, diesel fuel can sometimes fall into short supply. Thus, facilities must store sufficient supplies – enough to keep the generators running for 24, 48, or even 72 hours. Facility owners must then determine how much fuel to store, how to store it, and how to address the fire hazard. Some owners or facilities may desire to deal with these issues by burying the tanks, which necessitates EPA regulations.



The S1 Technology Center in London required a state-of-the-art datacenter with on-site, 24/7 operations control center for European operations. Features of the facility include redundant power with UPS and generator backup, dual fiber optic feeds and interconnectivity between the Norcross, Georgia and London datacenters allowing for dual control of network traffic, adding another level of redundancy. Client server racks are located on the main level, while network racks are located on the mezzanine level providing separation of Internet and Intranet traffic.

S1 London Technology Center, London, UK

Designers should challenge generator manufacturers to do two things:

1. Increase natural gas generators' technology such that they, too, can reach the increasing wattage needs of 2 megawatts and beyond.
2. Design a generator that can utilize a dual fuel source. Such a system would use natural gas as its base line, which would provide for a much longer run time without the need for refueling. A failsafe diesel fuel day tank would provide 24 hours of run time in case the natural gas supply is interrupted.

With these two approaches, datacenters could sustain themselves longer than ever imagined during a catastrophic event.

Battery Power

When a datacenter loses power, the uninterruptible power supply (UPS) system sees to it that backup batteries take the load immediately. Meanwhile, the generators come up to full load to support the facility coming back on line. As long as the end user can access diesel fuel, the facility can continue to operate. The batteries need only supply power for a few seconds.

In light of today's worldwide political turmoil, however, it is not impossible to imagine a power outage caused by some interruption to oil – and thus, diesel fuel – supplies. In this event, batteries may have to provide longer run times of four, eight, and 12 hours – enough to give managers additional flexibility in locating emergency diesel fuel supplies.

The Need for Improved Battery Technology

Datacenters have traditionally used wet cell batteries for backup power. Dry or gel cells cost less up front, but only last five to seven years, compared to a wet cell's lifespan of eight to ten years. If gel cells could be made to match wet cells' life expectancy, however, they might lower battery backup costs by an acceptable amount – given wet cells' maintenance requirements.

Wet cells require regular attention. Facility managers must constantly monitor them, periodically adding electrolytes to ensure continued electrical charges. Wet cells not only require this labor, they also take up valuable real estate. Typically, they are stacked in two-tier racks. More recent designs, in an effort to increase battery backup run time, have added a third tier to these racks. End users have resisted this change, though, because it adds to maintenance expense and increases safety risks to technicians.

Enter gel cells. Not only do they cost less than wet cells, but also do not require the same amount of maintenance. Thus, they cut labor costs, allow users to save square footage, and reduce overall building costs because they are more easily stacked into this 3-tier environment.

In order for such a plan to work, battery manufacturers must find ways to boost gel cells' life expectancy to match wet cells'.

In Closing

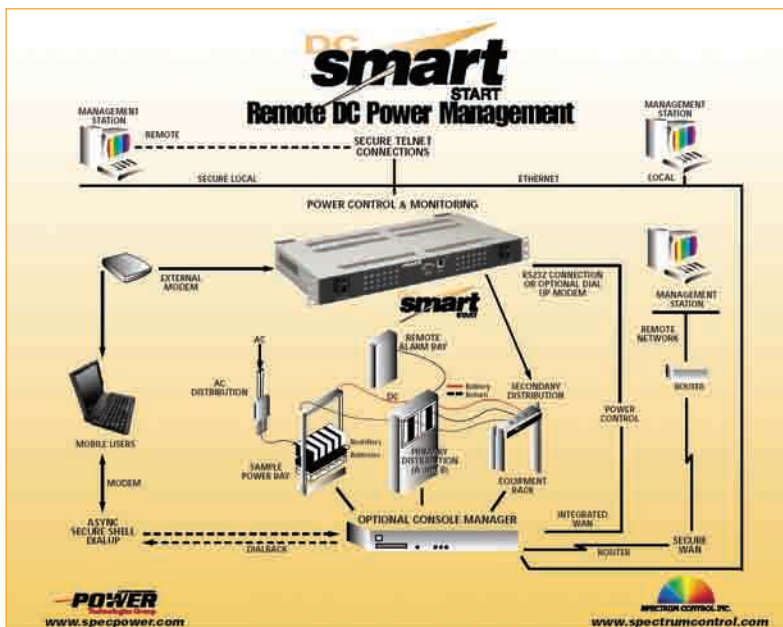
Water-cooled racks, natural gas/diesel-powered generators, and improved back-up battery technology/racking strategies are three potential ways that datacenter designers – and the entire industry – can support increasing cooling needs due to power demands. These solutions can also reduce costs associated with the increasing building square footages that larger infrastructures demand. As time passes, engineers may develop additional techniques, and one or two measures will emerge as viable alternatives to the others. Ultimately, such strategies will support increasing datacenter power and cooling requirements while remaining cognizant of the spiraling costs that affect companies' profits, and their datacenters' validity, around the world.

Johnny Hembree, AIA is Principal of Pieper O'Brien Herr Architects Ltd. He can be reached at johnny.hembree@poharchitects.com.



DC POWER DISTRIBUTION

Maximizes Network Uptime & Protects Infrastructure Hardware via Remote Management



CIO and CTO executives and their administration members are under constant pressure to maintain the unimpeded operation of massive amounts of Network Infrastructure equipment.

Several factors affect reliably running this critical infrastructure;

- Most notably is the uninterrupted supply of AC power
- Proper rating of circuit protection for the loads in the rack to avoid unintended circuit breaker tripping
- System lock up – when a system is no longer able to respond to external commands.

Datacenter managers have other elements that create issues of concern;

- Environmental Issues in a Datacenter accelerate fatigue and bring upon early system failure;
 - Temperature is the result of power consumption in a rack by the IT infrastructure contents in the Rack. This Temperature is a result of the AC power feeds, transmission losses, and the loading of the power supplies converting the AC supply and generating DC voltage internal to the device to power the equipment – all of this generates tremendous amounts of heat!

Many IT professionals unlike their peers in the Telco world may not be quite as familiar with the use of DC POWER as it would be applied towards their day to day infrastructure environment.

However as the technical community becomes more aware of the use of DC power (either -48VDC or +24VDC and in some cases +12VDC). They will become more aware of the use of DC Power Distribution and Circuit Protection appliances to replicate the power distribution appliances they have been accustomed to in supplying power to the IT infrastructure presently employed in AC powered Datacenters.

In essence it will be critical to have a device that is able to provide the administrator the ability to manage and remotely cycle power in a DC Power environment to equipment that may have ceased to respond to external commands or possibly have tripped a circuit breaker thus rendering the hardware non responsive yet there was no catastrophic fault “short circuit”.



DC SMARTstart

The advent of DC power in New Construction Datacenters is taking hold, as AC power and components add layers of potential supply interruption.

Spectrum Control has created a device that is known as a DC SMARTstart power distribution and circuit protection unit permitting users to manage their system’s power from anywhere, at anytime.

SYSTEM

by Leonardo Marsala

This rack mounted +24VDC or -48VDC (also available in +12VDC) system is low profile, lightweight and can reboot a network via Web, Telnet, and SNMP.

The intrinsic design of this PDU is to enable the installer the ability to configure a DC Solid State breaker panel to sequence power on or off while minimizing the degree of inrush current at any given time to prevent common overload trip conditions. These devices also provide real time battery voltage status feedback via the available means of communication.

THE ALL SO COMMON OVER-LOAD TRIP – can represent significant lost revenue! The amount can be on the order of 10's of thousands of

dollars per hour depending mostly on the type of business your team supports.

Management teams are cognizant of this factor and need to be aware of options in a product like the DC SMARTstart that can help minimize these significant financial losses.

The term we apply to these **OVER-LOAD TRIP** conditions is "No-Fault Trip" this is the result as noted above by "not providing sufficient head room" for the total peak current of all devices vs. the breaker rating chosen to protect the equipment. This condition is a prevalent reason for lost time.

To minimize the downtime this PDU family has a breaker auto reset function. The on board computer will pole the tripped channel position to determine whether there is indeed a fault, such as a short circuit. If this condition is determined to be non catastrophic, the breaker is reset. The client is able to disable this feature if desired.

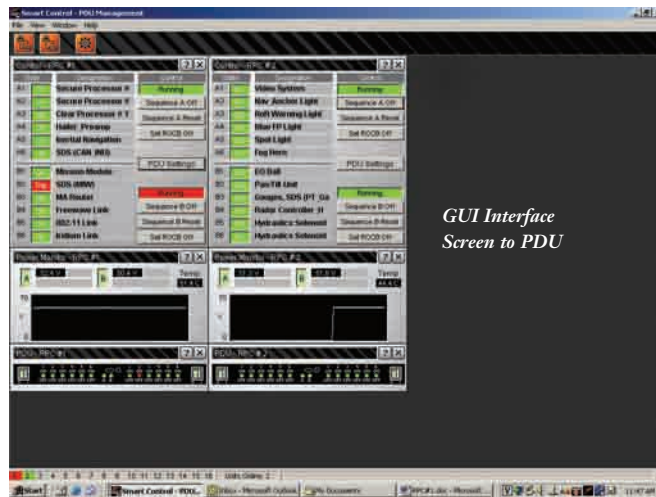
The true task of a Network Management Team is to create a management environment with all available information to build out the ideal model network footprint. To aid in this the DC SMARTstart style of Power Distribution Unit provides an on board event log that can be analyzed for critical historical patterns thus enabling intelligent decisions for preventative adjustments to infrastructure.

The DC SMARTstart styles of Power Distribution units are found in various applications;

- Credit Card Processing Datacenters
- Financial Institutions

High Speed Rail is ideal for automated test racks in ATCA, industrial and manufacturing applications, as well as any network power management situation where remote reboot and infrastructure protection are paramount.

Leonardo "Len" Marsala is Director of Marketing of Power Management Systems Group of Spectrum Control, Inc. He can be reached at marsala@spectrumcontrol.com.



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Circuit Breakers – Are You Protected?

by Kevin S. Arnold, P.E.

Denser cabinets with high power devices are driving today's power distribution needs. As this high density trend continues 208 V power and 3-Phase 208 V power is being brought down to the cabinet level. Most organizations consider this equipment mission critical with downtime measured in thousands of dollars for each minute a system is unavailable. With so much at risk a better understanding of overcurrent protection and the differences between fuses and circuit breakers protection is key to maintaining uninterrupted service when implementing cabinet level power distribution units (PDU's).

There are several approaches to providing overcurrent protection. This paper focuses on the differences between using fuses and circuit breakers. To explore this topic further selective coordination, component protection, maintenance, resetability and other issues are discussed.

Overcurrent protection is driven by the standard UL60950-1, Clause 2.7 which states that "standard supply outlets and receptacles shall be protected by an overcurrent protective device in either the equipment or the branch circuit, rated not more than the outlet or receptacle. The overcurrent protective device shall be of a type that is suitable for branch circuit protection in accordance with the National Electrical Code (NEC®) ANSI/NFPA 70..."

Branch circuit protective devices typically fall into two categories, molded case circuit breakers listed to UL489, or fuses listed to UL248. By definition, a circuit breaker is a means of automatically opening a circuit at a specified level of overcurrent, on either an overload or a short circuit condition. Fuses are also designed to open the circuit at specified levels of overcurrent. Fuses are typically the less costly up-front solution, and are replaced after each occurrence. Breakers are typically the more costly upfront solution and if listed to UL489 are large,, bulky and do not fit into a 1U enclosure..

Selective Coordination

Proper selective coordination eliminates unnecessary power outages and reduces costly downtime. Selective coordination is the act of isolating a faulted circuit from the remainder of the electrical system, while maintaining uninterrupted power to the unaffected circuits. The faulted circuit is isolated by the selective operation of only that Overcurrent Protection Device (OCPD) closest to the over current condition.

Fuses open the circuit when they 'see' a specific level of current passing through the fuse. Lower amperage rated fuses require less energy to open the circuit than higher amperage rated devices. This allows fuses to be very easy to selectively coordinate.

Circuit breakers require a coordination study to ensure selective coordination. Overlap of circuit breaker trip curves between the upstream and downstream devices often results in simultaneous operation of both devices. A circuit breaker system will clear the fault condition and open the circuit, but it will also remove power to all of the remaining loads being served by the PDU.

Component Protection

According to the NEC® 110.10, overcurrent protection devices shall be selected to permit the OCPD to clear a fault without damage to the electrical components of the circuit. By reducing the amount of energy that passes through to the protected device, you decrease the damage that reduces repair and downtime. In order to successfully protect sensitive equipment, the upstream overcurrent protective device needs to be able to operate in a very short amount of time, and consistently limit the amount of fault current/energy, which passes through to the downstream devices.

Fuse operation is based on a simple thermal principle; the internal fuse element will rapidly melt/vaporize, at a very specific level of energy. This amount of energy is well below the total amount of energy potential available during a faulted condition. The resultant clearing time and the subsequent let-through current is significantly reduced which results in less energy that a downstream component is required to withstand. Per UL248 listing, fuses are required to meet maximum allowable energy let through values under fault conditions, which allows for excellent protection of components.

Most thermal magnetic molded case circuit breakers are not listed and marked as current limiting. They do not interrupt short circuit currents in less than a cycle, and typically require a full cycle to clear a fault condition. This means that the full peak current and energy of the first cycle of the fault will be let-through. Per UL489 listing, standard thermal magnetic molded case circuit breakers are not tested to limit the maximum amount of energy let-through to downstream components.

Maintenance

Proper maintenance of overcurrent protection devices, as specified by the manufacturer, is critical to effectively and consistently operate within its manufacturing specifications in the event of an overcurrent condition. Fuses do not require maintenance. Molded case circuit breakers require periodic inspection and manual operation as part of their prescribed maintenance procedures. Failure to manually exercise the mechanism can cause the breaker to open slower than specified or not operate. The causes for this can be numerous, but one cause is the internal lubricants begin to thicken and harden. Most manufacturers recommend that if a molded case circuit breaker has not been operated, opened or closed, within six months time, it should be removed from service and manually exercise the mechanical operation and the tripping mechanism. "If operated outside of its ratings or without proper maintenance, catastrophic failure of the power system, circuit breaker, or switchgear can occur causing not only the destruction of the equipment but serious injury or even death of employees working in the area." (Refer to Dennis Kneitzel's white paper at <http://www.bussmann.com/library/arcflash/PDMaintPaper.pdf>)

Because of the highly engineered yet simple design, fuses ship from the factory calibrated to a very specific set of operating parameters. This ensures that the fuse will operate as specified without maintenance and upkeep concerns.

Interrupting Rating

According to NEC® 110.9 "Equipment intended to interrupt current at fault levels shall have an interrupting rating sufficient for the nominal circuit voltage and the current that is available at the line terminals of the equipment." Failure to comply can result in catastrophic failure of the overcurrent protective device, which will require replacement of the entire PDU, and an immediate loss of power. Worst case examples could result in a fire and/or explosion. All modern current-limiting fuses listed to UL248 employ a simple and reliable method of current-limitation and are able to easily achieve interrupting ratings of 100,000 amps or higher. Standard UL489 Circuit Breakers typically tested to safely interrupt much lower levels of fault current, and are not inherently current limiting.

Venting

When operating under a short circuit condition, as the contacts of a circuit breaker separate, an arc is created between the contacts. The circuit breaker utilizes arc-chutes to divide and dissipate the resulting arc. As a mechanical device, the breaker cannot internalize the resultant expansion of ionized gases. These must be vented 'safely' from the breaker into the surrounding equipment. These hot ionized gases can potentially damage other sensitive components. Fuses are required and listed under UL248 to contain any violence or fire that occurs during the internal arc that is created when the fuse opens under a short circuit condition.

This includes maximum amounts of physical deformity, of which very little is allowed.



A PDU with fused protection to UL248

Physical Attributes

The fuses utilized in many PDU's have a very specific physical footprint and rejection style fuse holder that prevents the wrong fuse from being installed. This prevents unqualified personnel from replacing an open fuse with a different fuse that may not provide the correct level of protection. PDU suppliers such as Server Technology utilize a Class G fuse, UL specifications file #E42730, which provides a very high degree of current limitation. Class G fuses have unique dimensions. Also, the dimensions are different based upon the continuous amperage rating of the fuse. After a fault occurs, fuses are replaced assuring the same level of protection that existed previous to the fault. This ensures a high level of protection and reliability, without concern for maintenance and potential mechanical damage inherent to re-settable OCPD's.

Resetability

There are several misconceptions concerning the suitability for using re-settable devices for reliable overcurrent protection. Per OSHA 1910.334(b)(2) after a circuit has been de-energized by the operation of a circuit protective device, the circuit may not be reenergized until it has been determined that the circuit can be safely energized. A qualified person is required to determine the cause of the overcurrent condition, and in the event of a short-circuit, fix the problem prior to reenergizing the circuit. Circuit breakers that have interrupted a fault approaching their listed ratings shall be inspected and tested to the manufacturers instructions according to NFPA70E 225.3. After a circuit breaker safely interrupts one short circuit fault, the breaker needs to be evaluated to determine if it can safely be put back into service, and it may need to be tested in order to determine if it will safely interrupt a short circuit in the required amount of time. This testing can involve taking the PDU out of service and taking the breaker out of the PDU. In some cases the breaker may need to be discarded and replaced.

Environmental Temperature Concerns

Fuses and many circuit breakers use thermal principles to sense overcurrents in a circuit. External temperature can affect the opening time of the OCPD, and could cause potential nuisance opening of the device. For applications in datacenters, the environment is very carefully controlled and the temperature has not been a concern.

Conclusion

When making the selection of overcurrent protection devices for applications such as power distribution for critical circuits; selective coordination, component protection, and maintenance must be taken into consideration. Fuses offer easy and reliable selective coordination, superior component protection and zero maintenance. Fuses are a simple, proven and effective means of providing reliable overcurrent protection, and reducing the energy let-through to sensitive downstream equipment. This will improve safety, decrease downtime, and maintain company profitability.

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The Seven Steps to Extremely Reliable Infrastructure

by Mike Hagan

Failures outside your facility are inevitable, but failures within your facility are not. While the time and place of the next hurricane, ice storm, utility outage, or human error can't be predicted, the results of such an event can. That's why the most mission-critical, technology-dependent organizations rely on high-availability infrastructure specialists to help assess, predict and mitigate the risks of infrastructure problems.

Infrastructure specialists can provide you with years of experience garnered from working over, under and around millions of square feet of raised floor, inside the most demanding mission-critical facilities. Whether you're starting from scratch, or are evaluating an existing facility, there are seven steps you can take to ensure that every link in the infrastructure chain has the strength, power and resiliency needed for 7x24 operational continuity.

A Double-edged Sword

Information Technology (IT) has fueled dramatic increases in productivity. However, this has also dramatically increased the costs of its loss and speed at which those costs are incurred. The numbers are astounding:

- One in 500 datacenters incur a severe disaster each year;
- Downtime costs the average U.S. business \$210,000 per hour;
- U.S. businesses with more than 1,000 employees lose about 2% of their annual revenue to network downtime;
- Up to half of all system failures can be attributed to environmental or physical failures.

The rate of advancement in the speed, capacity and reliability of information technology has been remarkable. However, it is equally remarkable that during the same time frame, many of the electrical and mechanical systems that support this advanced technology have remained fundamentally unchanged. Moreover, recent high-profile events further illustrate the weaknesses of an information age system fueled by an industrial age infrastructure.

The Seven Steps to Reliable Infrastructure

Step 1: Begin with the End in Mind

Whether new or existing construction, the best infrastructures are designed with the end in mind. This is best accomplished through a discovery process involving all key personnel. During this process, an experienced infrastructure specialist will guide you through the questions that are vital to determining the project's scope and desired outcome.

Current site conditions and user requirements will be evaluated to ensure potential problems are identified and addressed. The process details your organization's current needs, and anticipates future demands. In addition to business and technological concerns, external risk factors are considered, such as local and regional power suppliers, local climate, and the likelihood of severe weather events.

This is also the time to identify the skills and expertise you'll need on your team and to determine reporting procedures. In addition, the overall project schedule will be developed to anticipate and address any possible conflicts.

Look for a qualified infrastructure specialist with the resources to take your facility from drawing board to the real world. Design/Implementation services provide a seamlessly integrated methodology that expedites implementation, reduces costs, and ensures complete interoperability and functionality of your mission-critical facility. Review the firm's client list to ensure they have the experience and track record to make your project a success.

When upgrading an existing facility, it is particularly important to select a firm with expertise in working with critical loads. In some cases, work-arounds, temporary equipment and hot work may be required to protect critical loads.

Step 2: Making the Parts Whole

No datacenter is an island. World-class infrastructure is a collection of products and services strategically orchestrated into an integrated system that powers and protects your facility. Integration Services require a combination of management, technical and supervisory skills to ensure you receive the best infrastructure products, systems and services. Your Integration Team must possess detailed product and manufacturer knowledge, as well as engineering and construction expertise. Installing the right system incorrectly or using it in the wrong application can have a severe impact on your facility's reliability.

Your Integration Team must also make certain that all infrastructure-related components meet your availability requirements while delivering complete compatibility with your IT systems, physical environment, monitoring capabilities, and your business systems.

Typical Integration Services should include:

- Design Coordination
- Equipment Recommendations and Procurement
- Document Control
- Factory Witness Tests
- Delivery Coordination
- Installation Support



Step 3: Trust – But Verify

Plans on paper are essential, but infrastructure combines both the virtual world and the realm of the mechanical and environmental. It is bits and bytes as well as nuts and bolts. Commissioning is where designer's dreams and manufacturer's claims meet the real world.

Your facility's infrastructure is comprised of mechanical, electrical and control components and systems from numerous manufacturers, installed by a variety of specialized firms. The commissioning process systematically tests and balances each system to ensure that they are installed properly and operate as specified.

Site Commissioning Services must ensure that your systems perform at the highest levels, right from the start. The best commissioning experts adhere to a thorough quality management process that validates and documents your facility and its systems. Commissioning methodologies cover a wide variety of procedures to verify the integrity and performance of your mission-critical facility's infrastructure, including:

- Commissioning Plan Preparation
- Pre-start-up and Start-up procedures
- Integrated System Testing (IST)
- Operational Training and Turnover, including Development of Standard Operating Procedures (SOPs) and Methods of Procedures (MOPs)
- System (as built) Documentation

Step 4: Ensuring Bench Strength

In spite of all our technological advances, it is still human interaction that makes the difference between success and failure. When trouble occurs, it's the training, experience and dedication of on-site personnel that will either save or lose the day.

Top mission-critical facilities must have access to Staffing and Staff Augmentation solutions that place highly-trained maintenance personnel at your site. These Staffing Solutions provide expert personnel on-site to supervise/perform all maintenance tasks associated with your mission-critical environment, perform daily walk-throughs, and develop stringent operational and disaster recovery procedures based on best industry practices and the staffing firm's extensive expertise. Best of all, with the finest staffing solutions, you also benefit from the technical resources and experts that provide back-up to your on-site representative.

Step 5: Taking Care of What Takes Care of You

On day one your mission-critical facility's infrastructure is shiny and new, ready for virtually any eventuality. However, your mission-critical facility is operating 24 hours a day, 7 days a week. Wear and tear, time, and the elements all conspire to weaken your infrastructure.

Scheduled preventative maintenance and emergency services therefore must be tailored to each client's precise needs. The best firms offer computerized maintenance management systems that ensure maintenance is performed precisely as prescribed.

Step 6: Round-the-Clock Vigilance

The five preceding steps will minimize and prevent the majority of infrastructure problems that confront most mission-critical facilities. However, even the most expertly integrated, carefully commissioned and meticulously maintained infrastructure will one day (or night) face the unexpected. For all the advanced technology, there are things simply beyond your control. That's why the most technology-reliant organizations rely on outside sources to provide 24/7 facilities monitoring.

Remote monitoring services have the ability to monitor every piece of electrical and mechanical equipment in your mission-critical facility, no matter where it is located. The leading providers offer state-of-the-art national operations centers with:

- Multiple T-1 Connectivity
- Ultra-redundant Infrastructure
- Support of Multiple On-site Monitoring Systems
- Centralized Dispatch for Emergency Service
- Tailored Emergency Response Procedures
- Centralized Document Management System

Step 7: Keeping Good Company

Ultimately, the mission-critical facility runs on technology, trust and teamwork. A highly-available infrastructure is the result of the concerted efforts of CIOs, electricians, engineers, planners, technicians, managers, plumbers, cleaning crews and maintenance teams. Your infrastructure provider works to orchestrate and coordinate the efforts of this diverse team to ensure your mission-critical facility delivers the performance and availability you require.

For an asset as crucial as your mission-critical facility's infrastructure, it pays to invest the time to select a company you can trust, with the experience and resources to maximize uptime and mitigate risk. Ideally, your mission-critical infrastructure specialist will offer you all of the products, people, services and strategies needed to design, integrate, commission, staff, maintain, service and monitor your facility. Acquiring these crucial services from a single source can greatly reduce headaches and finger-pointing in the future.

Whether you're building a new facility or upgrading an existing one, following these seven steps to extremely reliable infrastructure is the most certain path to the strength, power and resiliency needed for this increasingly technology-reliant world.

Mike Hagan is Senior Vice President of Lee Technologies. He can be reached at mhagan@leetechnologies.com.

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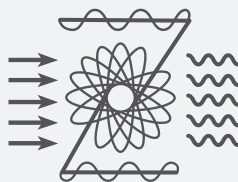
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Arc Fault Protection in IEC low-voltage systems.

by Stefano Rota

Abstract – Technical report IEC 61641 (Guide for testing under conditions of arcing due to internal fault) applies to enclosed low-voltage switchgear and controlgear assemblies manufactured according to IEC 60439-1. This test is subject to an agreement between manufacturer and user and is not considered to be a type test. The sole purpose of this test is to assess the ability to the assembly to limit the risk of personal injury resulting from an internal arcing fault. It is intended to amend IEC 61641 to cover plant protection, too.

Article

The first international standard regarding the performance of internal arcing tests in low-voltage switchgear systems was published in 1996 (IEC 61641) and the aim was to detect the effects of a possible internal arc on the safety of the operating personnel.

Technical report IEC 61641 (Guide for testing under conditions of arcing due to internal fault) applies to enclosed low-voltage switchgear and controlgear assemblies manufactured according to IEC 60439-1.

Despite the ever growing experience of the manufactures and operators of switchgear and controlgear systems, there is some residual risk of internal arc generation.

Internal arcs may be the result of:

- external influences, e.g. tools forgotten inside the system, or any remaining material residues after maintenance or conversion work;
- conductive deposits on isolating supporting elements under unfavorable environmental conditions.

If the gases and decomposition products resulting from the faults described are capable of bringing the gap between two neighboring phases, an arc will be fired with current intensities of several thousand amperes and temperatures up to 10,000°C (about 5,500°F). These conditions will result in a strong pressure built up inside the switchgear.

The resistance to internal arcs refers to two different aspects:

- personnel safety for the operator and maintenance personnel;
- plant safety in order to limit the damage within the system and to quench the internal arc within specific area and functional compartments (currently only VDE part 500 already gives a testing guideline to limit the risk of a damage of the plant).

The basic safety philosophy to realize arc fault protection should consider the following classification and arrangement:

- active protection: an arc fault should be prevented from occurring in the first place by designing and dimensioning the equipment absolute reliable;

- passive protection: if a failure should occur it is limited to its place of occurrence and consequent damage is minimized;
- fault free zone: this allows manufacturer to reduce the short-circuit strength for the components including the distribution bars to the load connection terminals of each functional device, to the value of the reduced short circuit stress present on the load side of the scpd.

The test arrangement is generally performed considering the following:

- Voltage: the applied voltage of the test circuit shall be at least equal to the highest rated voltage of the assembly, with a tolerance of +5%;
- Current: the test current should be specified by the manufacturer and it can be lower than the rated short time withstand current;
- Duration: this value is given by the manufacture and it is chosen according to the time response of the electrical protection devices. If the details regarding these devices are known, a proper supply duration of at least 0.1 second is applied. Normally this duration should not 0.5 seconds. When the assembly is intended to be fed by a transformer, the permissible arc duration of the incoming switching device should be in general 0.3 seconds to allow the operation of the high-voltage protective equipment.

The assessment of the arc fault test is than based according to the following criteria:

1. whether correctly secured doors, covers, etc. do not open;
2. whether parts of the assembly, which may cause a hazard, do not fly off;
3. whether arcing does not cause holes to develop in the freely accessible external parts of the enclosure as a result of paint or stickers burning or other effects;
4. whether the indicators arranged vertically do not ignite (indicators ignite as a result of paint or stickers burning are excluded from this assessment);
5. whether the equipotential bonding arrangement for accessible parts of the enclosure is still effective.

Stefano Rota is Projector Manager Export of ABB Inc. He can be reached at stefano.rota@it.abb.com.



American Express operates in a competitive marketplace where consistently meeting the customer's needs and expectations are paramount to its success. With the company's vision, "To be the World's Most Respected Brand"; quality, availability and reliability must be at the top of the list of metrics measuring service level performance. American Express strives to ensure the customer service experience leaves a first class impression. To Datacenter Facilities (DCF), this translates into meeting customer and applicable regulatory requirements; and continually improving performance.

American Express is a global financial and travel related services company processing billions upon billions of transactions annually. All these transactions are processed through systems whose infrastructure support is managed, maintained and operated by the DCF organization located in Phoenix, AZ and Minneapolis, MN. Throughout its tenure,

gap analysis of existing management practices, core processes (products and services), procedural /work instructions, training and documentation was conducted. Only minimal changes and procedures were necessary for conformance to ISO 9001:2000; therefore, the DCF Leadership Team put their Quality Management System to the test. Great Western Registrar, LLC, a 3rd party registration and certification provider, was able to validate the ISO certification and registration process. At the conclusion of the analysis, it was clear DCF had achieved a significant milestone. On November 7, 2004, the American Express Datacenter Facilities' Quality Management System became an internationally recognized ISO 9001:2000 registered organization/service provider. By no means does the certification/registration imply DCF has a perfect quality management system, or that work has stopped. Each activity



DCF has consistently demonstrated 99.999 ratings for continuous availability. The DCF Leadership Team recognized continual process improvement was necessary to achieve 100% availability. Our goal was to incorporate process approaches which would ultimately lead to streamlining processes and the operating budget. The logical progression resulted in adopting or exceeding the quality management standards the International Community subscribes to regarding services and products: ISO 9000 Series Standards.

ISO (International Organization for Standardization) is the world's largest developer of standards. Although ISO's principal activity is the development of technical standards, ISO standards also have important economic and social repercussions. For businesses, the widespread adoption of International Standards means suppliers can base development of their products and services on specifications that have wide acceptance in their particular business markets. This, in turn, means businesses using International Standards are increasingly free to compete in many more markets around the world.

ISO 9001:2000 focuses on "quality management" and it is now the only standard in the ISO 9000 family against whose requirements a **quality management system** can be certified by an external agency. In the fall of 2004, a Consulting Agency benchmarked the DCF quality management system against the Standard. As a part of the benchmarking process, a

or process should and must be reviewed and evaluated on a recurring basis to determine their added value and effectiveness. Additionally, internal audits and annual assessment audits are conducted to assess continual conformance to the Standard. There is some work involved in maintaining conformance; however, the benefits far outweigh the maintaining efforts.

One of many benefits stemming from implementing a quality management system approach is the ability to identify opportunities for continual improvement. Since adopting and implementing ISO 9001:2000, individuals within the organization have identified and implemented more than sixty (60) continual process improvement efforts. These improvements have streamlined processes and added value to the overall success of the organization.

Developing and implementing an effective internal auditing process is another benefit which has added significant value. Several DCF members attended and successfully completed a Registrar Accreditation Board (RAB) certified ISO 9001:2000 Internal Auditor Training Course. This course provided the foundation for understanding and implementing the "process approach" to conducting internal audits. Audit plans and criteria were developed for each department within DCF. The stage was set for measuring and benchmarking core processes against the Standard and for their effectiveness towards achieving DCF

Quality Objectives. Thus far, the benchmarking of individual processes has proven to be a valuable tool for improving the effectiveness and efficiency of:

- Standardizing the control of documentation
- Establishing procedures to ensure consistency in training qualifications
- Monitoring and measuring the fulfillment of service level agreements
- Establishing compliance with standards and other operating directives

Upon adopting and implementing ISO 9001:2000, DCF quickly recognized enhancements in internal and external customer service relationships. Internally, agencies within American Express were able to leverage and market DCF as a truly “World Class” organization, with impressive credentials

provider, was contacted for assistance with the resolution process. Based on a mutual understanding of the Standard requirements, a joint collaboration effort ensued which resulted in a visit to the Manufacturer’s production facility. Both teams engaged in peer-to-peer discussions and participation in the root cause analysis process. Together the teams investigated information and processes relating to manufacturing design and production techniques. They identified a gap in the production process involving the barrier material and adhesive product application: this ultimately was the root cause to the problem. The team documented a comprehensive forensic report to include photographs of the corrective actions and they collaborated on the prototype solution and acceptance testing. This effort resulted in a more reliable product for DCF; a process improvement for the Manufacturer; and a fostering of better relationships between customer and supplier. This

a Competitive Edge?

by Sterling R. Kennedy

and certifications. This reinforces customer assurance while attracting global customers and partnerships. At every level within the organization, team members are eager to provide input, services and products focused on ensuring 100% availability and customer support. Externally, DCF has improved its customer relationships with ISO 9001:2000 certified suppliers and service providers. Most recent engagements include receiving services or products from companies such as Magnetrol International, Eaton Cutler Hammer, Tucson Electric and Power (TEP), Newark InOne Services, TSI Incorporated – Alnor Products, Acterna, The Fluke Corporation, Salisbury, Commercial Radiator, Siemens and Orkin Pest Control... just to name a few. The enhancement in customer service relations is not “one-sided”; the benefits are shared between all parties involved.

Recently, DCF experienced a higher than usual failure rate with skid mounted generator circuit breakers used in support of one of the DCF managed facilities. This discovery took place during the internal testing process which is done prior to equipment installation to avoid customer impact. In relations to the Standard, this incidence is known as “an occurrence of nonconforming services or products”. This required DCF to investigate, provide a root cause analysis to the problem and develop safeguards to prevent the recurrence. The Supplier/Manufacturer, an ISO 9001:2000 certified service

openness and willingness to work together as a partnership can be directly attributed to an ability to leverage the mutual involvement in ISO 9001:2000 certification process.

DCF continues to gain successes and improvements which add value to the business of American Express. Adopting and implementing ISO 9001:2000 has reinforced the structure of the DCF quality management system. All employees are prompted to re-evaluate processes, identify opportunities for improvement and foster better customer relationships. In a competitive market, quality services and products are vital to the success and survival of all companies and businesses. Increasingly, companies and businesses are becoming ISO 9001:2000 certified because they realize the benefits outweigh the risks. Therefore, a trend is emerging where more and more companies and businesses on the open market are obtaining their goods, products and services from companies or businesses who are ISO certified. What about you? If you haven’t done so already, take a look at your management system and processes and re-evaluate your ability to maintain a competitive edge.

Sterling R. Kennedy is Senior Technical Writer of American Express Data Center Facilities. He can be reached at sterling.r.kennedy@aexp.com.

American Express Data Center Facilities – Achieving “World Class” Expectations through ISO 9001:2000, Quality Management System

INSIDE 7x24



2006 Fall Conference Highlights

The Fall Conference themed “End-to-End Reliability: Mission Critical Metrics” will be held November 12-15 at the Hyatt Regency Gainey Ranch in Scottsdale, AZ. The Fall Conference will feature compelling keynotes, case studies, a motivational general session presentation, an increased number of concurrent and tutorial sessions, a spectacular vendor event, guest activities and more...

John Ryan, Vice President for American Express Technologies will deliver the opening keynote address entitled “Is There A Difference Between ‘7x24’ and ‘Always On?’”. Through this case study John will review how translating system diagnostics into business metrics creates real value.

The Tuesday general session will feature special guest speaker Chris Gardner on the topic “Breaking Cycles: A Rags-To-Riches Story from Homelessness to Wall Street”. Chris Gardner is the head of his own brokerage firm and owner of three homes, a collection of tailored suits, designer shoes, and Miles Davis albums – but just 20 years ago, Gardner was homeless, carried all his possessions on his back, and lived – on occasion – in a bathroom at a Bay Area Rapid Transit station in Oakland, California. A true testament to the perseverance it takes to make it from “rags-to-riches”, Gardner tells his story of overcoming obstacles, “breaking cycles”, and the motivation it takes to make your own success. Gardner's first book, *The Pursuit of Happiness*, is an account of his life story and was released in June 2006. Columbia Pictures has also completed production on a feature film based on Gardner's rags-to-riches tale. It stars Will Smith as Gardner and is scheduled to be released on December, 15 2006.



A panel of experts will deliver Wednesday's keynote address based on their real life case study. The presentation, entitled “High Density Cooling: A Practical Application for Water in the Datacenter” will demonstrate a cost-effective, forward looking solution for common datacenter cite challenges such as space utilization and cooling.

In addition to the enhanced programming 7x24 Exchange conference attendees will witness the evolution of the ever popular Vendor Sponsored Event as we present an evening with

the Grammy/Golden Globe and Oscar winning recording artist



Christopher Cross. His self titled debut album appeared in 1980, with the lead single “Ride Like the Wind” rocketing to the number two spot; the massive success of the second single “Sailing” made Cross a superstar, and in the wake of two more Top 20 hits, “Never Be the Same” and “Say You'll Be Mine”, he walked off with a record

setting five Grammy's in 1981, including Album of the Year and Song of the Year. **Special thanks to the following organizations for making this event possible: ABB, Active Power, American Power Conversion, Caterpillar, ComRent, Cummins Power Generation, Danaher Power Solutions, DataAire, Data Space Advisors, Eaton, Enviroguard, Emerson Network Power, EYP Mission Critical Facilities, Kohler Power Systems, MGE UPS, Mitsubishi Electric, MTU/Detroit Diesel, Power Distribution Inc, Russelectric, SIEMENS, Square D, Starline Track Busway and Syska Hennessy Group.**

New this Fall are an increased number of tutorial sessions on various topics and the Scottsdale “Shop Til You Drop” Shuttle for conference guests. 7x24 Exchange has been offering tutorials for several years now. The purpose of these tutorials is to provide material refreshers for those attendees familiar with the concepts and to provide a foundation to other attendees to increase their knowledge base in any particular subject area. Tutorials will focus on Datacenter Commissioning; Fire Protection Systems; Leveraging Dual Power for Availability SLA; Fundamentals of UPS Batteries and Fluid Mechanics.

Spouses and guests of conference attendees can “shop til they drop” with the multitude of shopping available in Scottsdale and Phoenix! Guests will have the opportunity to shop the top shopping areas in the Valley of The Sun including El Pedregal, The Borgata, Biltmore Fashion Park, Scottsdale Fashion Square, Old Town Fifth Avenue, and Kierland Commons and also pick up souvenirs and mementos of the visit to Arizona.

For the complete Fall Conference program and registration information please visit 7x24exchange.org or call (646) 486-3818.



Fall 2006

End-to-End Reliability: **MISSION CRITICAL METRICS**

November 12-15, 2006

Hyatt Regency Scottsdale at Gainey Ranch
Scottsdale, AZ

SAVE THE DATE!!!

SPRING 2007

June 3-6, 2007
Boca Raton Resort & Club
Boca Raton, FL
Theme TBD

FALL 2007

October 28-31, 2007
Gaylord Texan
Grapevine, TX
Theme TBD



European Chapter News Updates!!!

by Rebecca Bruce

The 7x24 Exchange International European Chapter launched for the first time in London, holding the event at the famous ExCel venue in London Docklands on the 28th June.

Exhibitors for the full day event included, Dell, AFCO, ITEC, Nova, FLunet, Pillar, GMT, Aperture, SNS, Wrightline, EYP, Future Facilities, Prism, IX Consulting, Knuerr, Terasaki, Server Technology, Load Bank, KST, Line Management, Minkels, Meesons, Twenty First Century, Wagner, APC, Schroff, Rittal, GDCM, Schneider, Montair, and Sapphire Controls, all being major players in The European Mission Critical Market.

Seminars were a great success conducted throughout the day in three halls, discussing key industry topics with many guest speakers. The evening dinner was held in a stunning venue in the Docklands over looking the River Thames, with guest speaker Bob Cassiliano, 7x24 Exchange International Chairman, and Will Carling OBE and former England National Rugby Team Captain. The day was an outstanding success, with many interactive products on display, representing all of the latest innovations for Mission Critical Environments. All areas of Data Centre build were represented including Servers, Cabinets, Door entry systems, CFD Modeling, UPS Systems, Switchgear etc.

Due to the success of the event, the chapter is already planning the next event to be held in ExCel in March 2007. There will be an exhibition of service providers and vendors and unique to an event like this, and uniquely, a working data centre of approximately 2000 square feet within the exhibition hall for exhibitors to test their products live to potential clients!!! Reservations will be accepted on a first come first served basis.

The first newsletter went out last Spring followed by another in September updating members of industry events and issues. The 7x24 Exchange European Chapter will now begin collaborating with organizations to submit white papers and technical reports.

Seminars are being organized every other month for the year 2007, focusing on key issues in the industry. The chapter is holding a dinner dance for members, guests, clients and partners to see the end of the year out with a celebratory evening. The dinner dance will be held on the 7th of December with up to 400 guests. The evening is being held on the stunning Silver Sturgeon boat, cruising on the River Thames, with champagne reception, three course gourmet dinner and drinks, Christmas crackers and novelties with a disco for the dancers! There will also be guest speakers to celebrate the evening from key organizations in the industry.

The chapter's Board of Directors provide their support offers respected opinions from various disciplines of managing and delivering a mission critical facility. We would like to thank the European Chapter Board for their time and support in shaping the chapter:

David Keegan – ITEC

Stephen Ford – ITEC

Rebecca Bruce – ITEC

Paul Hillier – M-E Engineers

Nigel Rothwell – IBM

Craig Harffey – Barclays Capital

Peter Austen – Barclays Capital

Bill McHenry – JP Morgan Chase

Mark Howell – Fords Motor Company

Mike Liddle – IFMA

Peter Koch – Knuerr

Kevin Barry – PTS Consulting

Mark Lillycrop – Arcati

Mike Tobin – Red Bus

Tarek Meliti – TDM Group

Michael Dyke – EDF

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Following are the Editorial Guidelines for Newslink together with the Member Advertising Rate Card. Advertisers interested in placing an ad may fax the insertion order to 7x24 Exchange at 212.645.1147 or email to jeremy@7x24exchange.org. Questions? Please call Jeremy O'Rourke at 646.486.3818x109.

NewsLink

Member Advertising Rate Card

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1/4 Page	500	450	400

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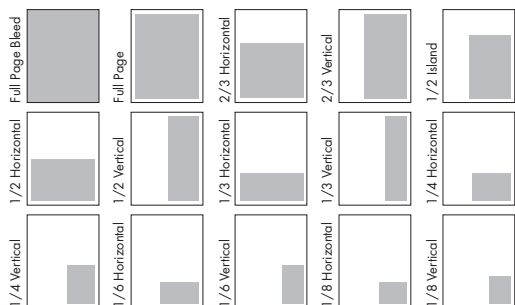
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1/4 Horizontal	4.5"	3.25"
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Manuscript specifications: Feature articles vary in length from 500 to 2,000 words. While Newslink accepts articles in a variety of formats, it prefers to receive materials on CD. All articles must be received by the deadline to be considered for a specific issue. Material submitted after the deadline will be considered for the following issue.

Bylines: All articles should include a brief (1-2 sentence) author biographical sketch at the end of the article, that includes the author's name, title, affiliation, address, and phone number. Photos of authors are never used. Newslink does not pay authors for contributions.

Visuals: Authors are encouraged to submit photographs and charts, graphs, or other illustration that will help readers understand the process being described, though it does not guarantee that visuals will be used with the article. Submit all charts, graphs, and other artwork separately; do not incorporate them in the body of the article. Indicate caption material separately. Newslink reserves the right to publish submitted visuals.

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CORPORATE LEADERSHIP PROGRAM MEMBERS

Fall Conference 2006

End-to-End Reliability: MISSION CRITICAL METRICS

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