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7X24 Exchange® INTERNATIONAL

THE END-TO-END RELIABILITY FORUM™

OPTIMIZING DATA CENTERS: TYING IT ALL TOGETHER

PAGE 7

CONFERENCE KEYNOTE

Céline Cousteau
Explorer and Filmmaker

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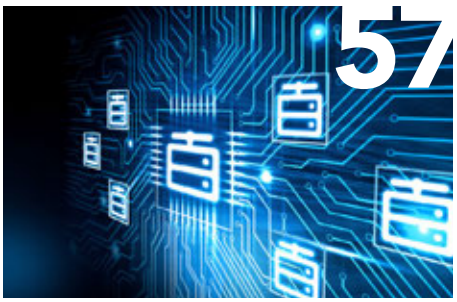
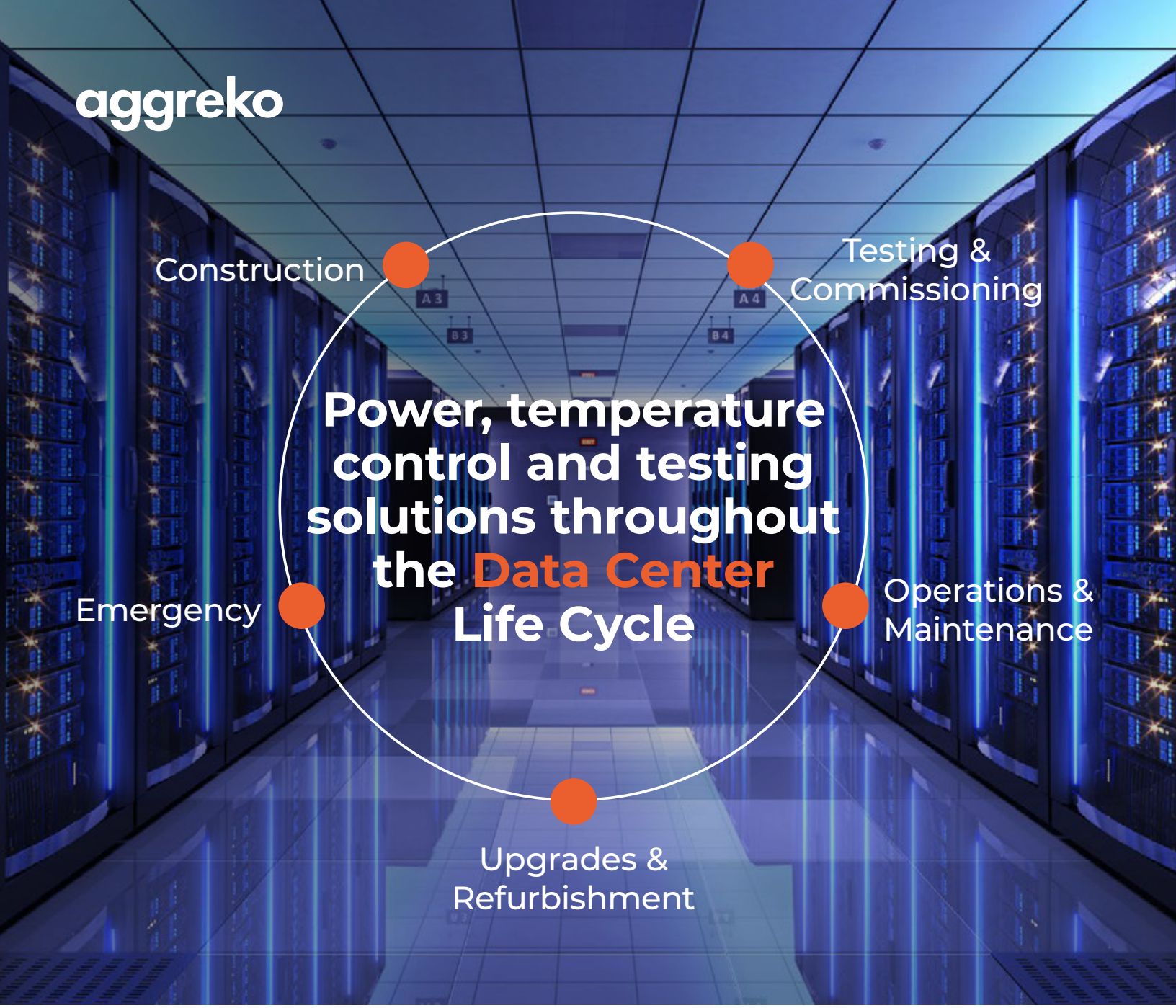


As a service to assist our valued members in staying informed about our dynamic industry, 7x24 Exchange is pleased to publish 7x24 Exchange® Magazine, offering articles by leading professional experts on current and future trends, best practices, and the state of our industry. Please note that the opinions and views expressed in these articles are those of the individual authors themselves, and do not necessarily reflect the views of 7x24 Exchange or any of our members.



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Robert J. Cassiliano

The focus for the 2023 Fall Conference is sustainability. According to Data Centre Magazine Data Centers are estimated to be responsible for up to 3% of global electricity consumption today and are projected to touch 4% by 2030. The average hyperscale facility consumes 20-50MW annually – theoretically enough electricity to power up to 37,000 homes. This current usage and predictions for increased energy consumption in the future will undoubtably bring about government regulation. Water consumption required for Data Centers to operate effectively is of additional concern.

The Data Center industry has been maligned by the media and others for its use of energy resources. Considered by some as energy hogs with no regard for the environment. Nothing could be further from the truth as the Data Center industry has demonstrated its commitment to the environment by making significant strides in energy efficiency, water usage, and sustainability.

Some examples are advances in chip design and manufacturing that limit server power consumption, increasing Data Center operating temperatures, focusing on renewable energy sources, utilizing aquafers and rivers for cooling, selecting locations were climate allows for a decrease in energy and water consumption, developing metrics like Power Utilization Efficiency (PUE) and Water Utilization Efficiency (WUE) and tools such as the Green Grid's total cost of ownership calculator, and looking toward the future with Hydrogen Fuel Cells. The Data Center industry has addressed environmental issues and is committed to doing more.

The goal of 7x24 Exchange conferences is to provide attendees with quality education, networking, and information sharing all in an environment designed for a memorable experience for attendees and guests. 7x24 Exchange is committed to providing value to members, conference participants, and their companies.

The theme for the 2023 7x24 Exchange Fall Conference being held at the Gaylord Texan Resort in Grapevine, Texas from October 8-11, 2023, is End to End Reliability: "Sustainability Opportunities". Conference highlights are as follows:

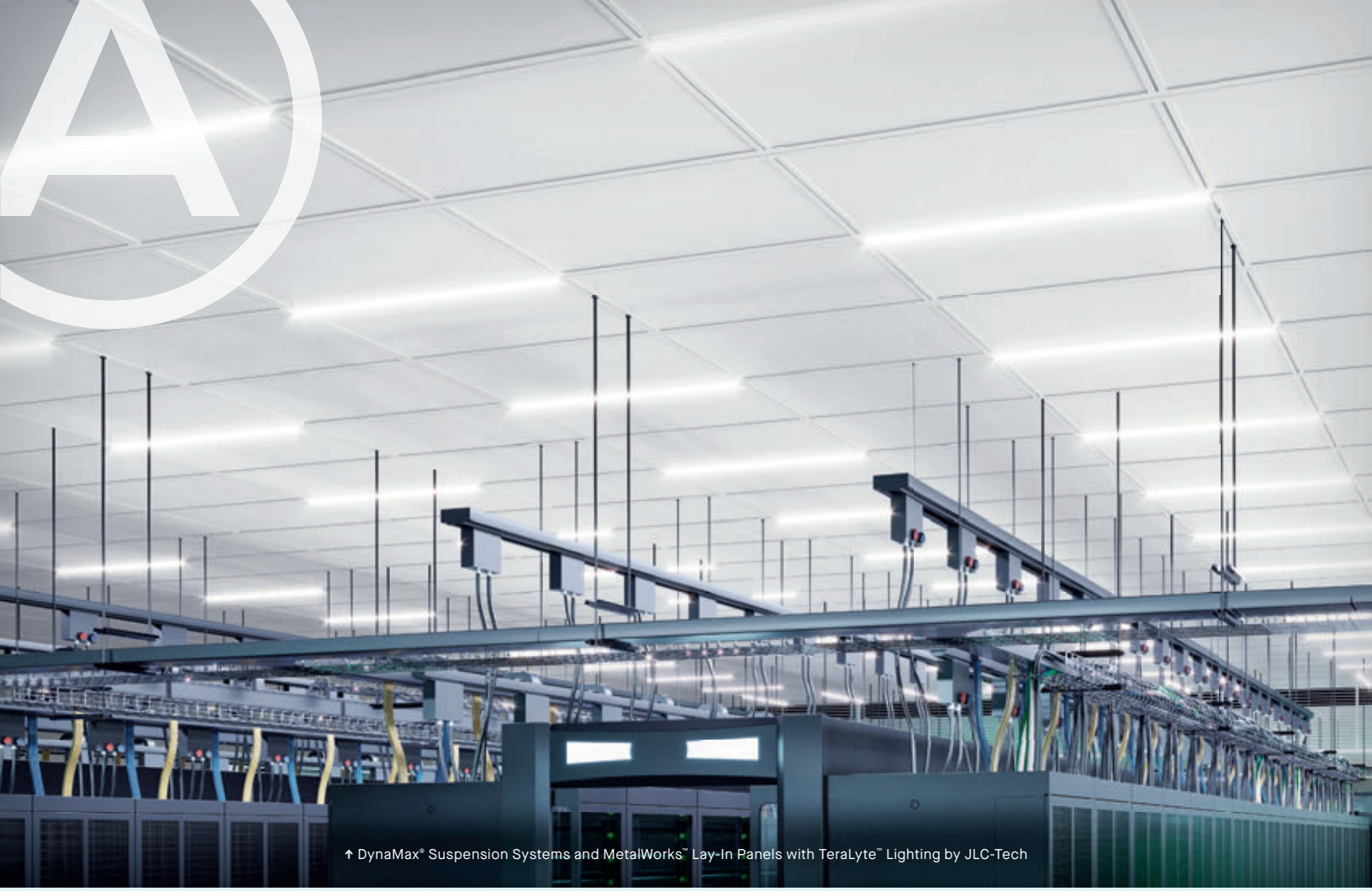
- Sunday evening Welcome Reception
- Conference Keynote: "Inspired and Connected – People and the Natural World" by Celine Cousteau, Explorer and Filmmaker
- Keynotes by Aligned Data Centers and Siemens
- Panel on Harnessing the Power of AI: Navigating the Environmental Sustainability and Climate Resilience Impacts on Data Centers – participants include AMD, Cyrus One, HP Enterprises, and Ramboll
- Panel on Adobe Data Center Case Study – participants include Adobe and Alfa Tech
- Talks from Compass Datacenters, Enchanted Rock, Last Energy, WB Engineers+Consultants, and Uptime Institute
- Panel on Don't Fear Liquid Cooling – Plan for IT – participants include Aligned Data Centers, Equinix, Flexential Data Centers, and Open Compute Project
- Panel on The Elephant in the Room: An Industry / University Perspective on the Current and Future Challenges in Data Center and Sustainability – participants include Binghamton University, Honeywell, Meta, Vertiv, and Villanova University
- Panel on Increasing Sustainability through Modular Data Center Design – participants include Integra Mission Critical, Skybox Datacenters, Telios and ZincFive
- WiMCO® Networking Reception on Monday sponsored by Meta
- Monday Evening Marquis Partners + Showcase: "Denim & Diamonds"
- Exchange Tables on specific topics at Tuesday lunch
- Tuesday Night Sponsored Event "Rock n Roll BBQ"

The program content is designed to provide value to conference participants and their companies by focusing on important topics of the day. Artificial Intelligence (AI) in Data Centers and Sustainability are highlighted at this year's Fall event.

I look forward to seeing you at the Fall Conference in Grapevine, Texas!

Bob

Bob Cassiliano presents Conference Keynote, Florent Groberg, with a donation to the "Adaptive Training Foundation" on his behalf.



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OPTIMIZING DATA CENTERS: TYING IT ALL TOGETHER

by Bob Haley
Chad Harrill

SUMMARY

Most if not all organizations are seeking to maximize their computing capabilities while controlling energy consumption. Today's data-driven environment demands efficient and immediate access to applications, information data and data analysis. The optimization of data center energy infrastructure has emerged as a critical component in the reduction of a facility's carbon footprint while working to meet digital demand. We will explore various strategies and technologies available today, that can be considered in a holistic data center consolidation and optimization approach: an approach that enhances digital resource availability, increases energy efficiency, scalability, redundancy, and overall operational effectiveness.

PRELUDE

This exploration provides an agnostic overview of the important role data center optimization plays in energy conservation, its significance in supporting digital operations and the desire of organizations to meet the ever-evolving demands for information. The individual technologies discussed will not solve the issues as a standalone solution, yet when combined offer organizations opportunities to increase their digital capabilities, while controlling overall energy consumption costs.

The purpose of this thought piece is to offer technical solutions to address the challenges facing data center operators, Information Technology (IT) managers or their organizations, and to raise awareness of the growing potential to reduce our carbon footprint, data center energy consumption, and to prompt dialogue between IT managers and data center operators. A collaborative solution can be developed when these teams work together to explore strategies for the consolidation, optimization and convergence of data center, IT hardware, applications, and facilities control systems.

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The total number of global data center facilities is on the rise, resulting in an expected 35-40 gigawatts (GW) of electrical power consumption by 2030, more than doubling the 17 GW in 2022 to an anticipated 2.2% of the world's power consumption, according to the McKinsey analysis article January 17, 2023. For reference, one gigawatt-hour (GWh) is equal to 1 million kWh. 1 GW could power approximately 876,000 households for one year if they collectively consume 10,000 kWh each as referenced in a study by Zach Stein, Carbon Collective, July 19, 2023.

The importance of the development and implementation of a comprehensive Facilities Operational Environmental Control Management (FOECM) strategy includes an IT systems Geographical Virtualization Load Balancing (GVLB) approach, coupled with the use of renewable energy sources, when possible, to reduce data centers current GW, and anticipated overall global energy consumption.

DATA CENTER INFRASTRUCTURE AND CONSOLIDATION OPTIMIZATION

This naturally leads to exploring techniques to consolidate and optimize the physical infrastructure of the data center such as rack configurations, power, and cooling systems. Data center operators face numerous challenges including meeting their facilities electrical, cooling, and redundancy needs, while supplying a resilient robust and scalable facility. The digital mediums regularly used in our everyday lives continue to grow exponentially. Data center operators and IT managers are being asked to meet these demands, while controlling operational costs, maintaining energy efficiency, and offering highly resilient redundant infrastructures.

The opportunity exists for collaboration between the IT, facilities manager, and control systems vendors to develop and deploy a holistic Data Center Information Management (DCIM) that is consolidated into the data centers Building and Power Management Systems (BMS/PMS). DCIM focuses on the monitoring, managing, and optimizing of the physical infrastructure including power distribution, cooling systems and equipment management. DCIM incorporates real-time analytics for the facilities operators to see overall energy consumption, allowing decisions to be made that better optimize their facilities.

In larger more complicated facilities, the Supervisory Control and Data Acquisition (SCADA) manages industrial processes such as power generation and water treatment. The SCADA system offers a centralized monitoring platform to gather and utilize real-time information to manage operations using remote devices and Programmable Logic Controllers (PLC's) with Human Machine Interfaces (HMI's). SCADA and BMS systems utilize different network protocols to communicate. Modbus, DNP3, OPC are very prevalent in SCADA systems while BACnet is common in BMS systems.

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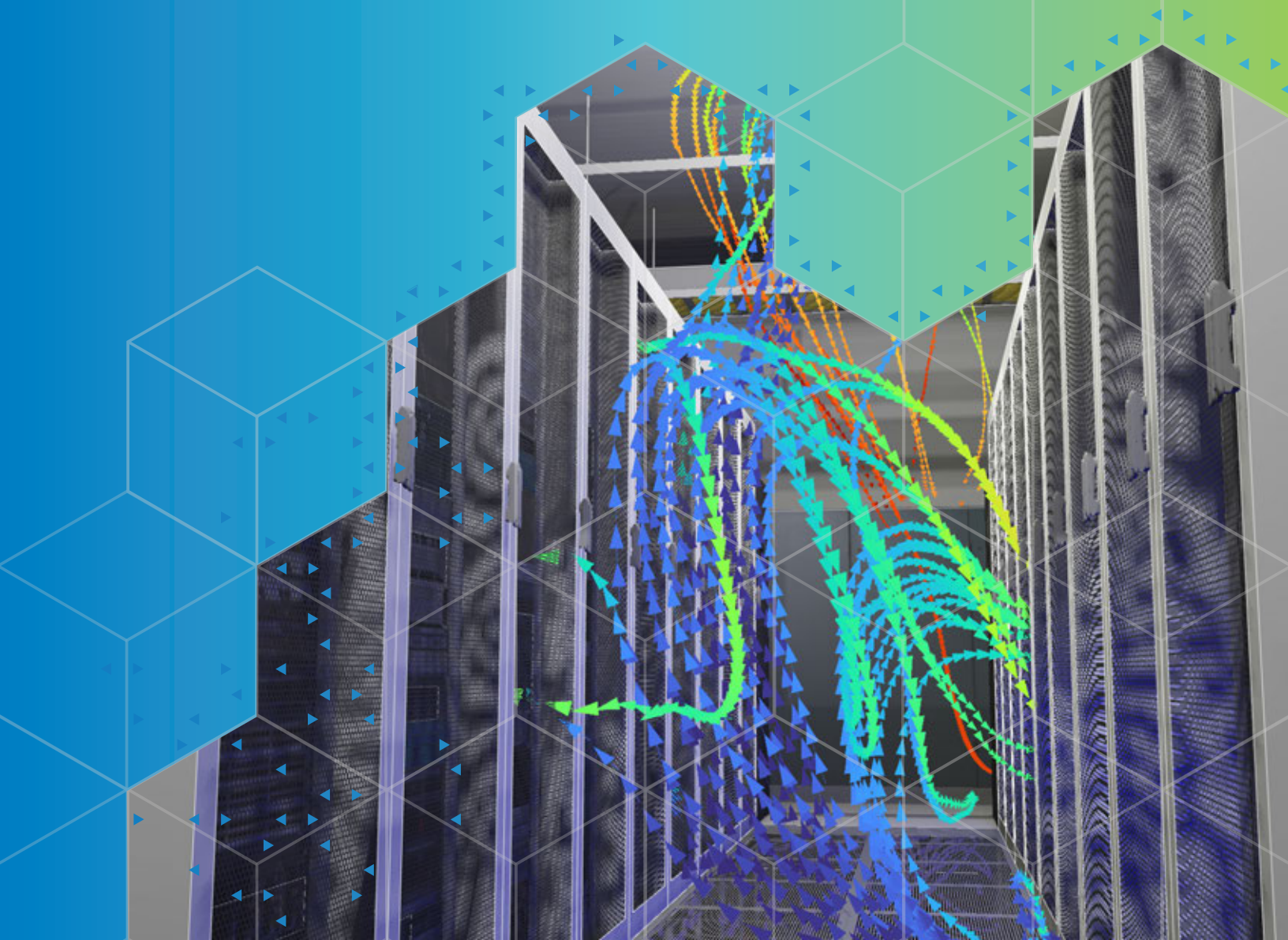

The integration of a SCADA system into an integrated optimization strategy will add a level of complexity for automated controls implementation. Although these network languages can communicate with the use of a gateway device, translation may be necessary adding another layer of complexity and potential security challenges into the overall optimization strategy.

Integrating DCIM, BMS/PMS and IT systems provides an overarching configuration that enhances the operational capabilities while reducing multi-systems complexity that most data center operators encounter. This integrated approach results in improved coordination between data center cooling and electrical systems to reduce consumption thus leading to a reduction in costs.

Optimizing server, storage, and networking hardware is an ongoing and evolving process. As hardware and energy saving technology advances, equipment life cycle management analysis will become a large part of the strategy. New equipment will offer the latest in energy saving components as well as software to manage the equipment.

SOFTWARE DEFINED DATA CENTER (SDDC) IT INFRASTRUCTURES

The key components of a Software Defined Data Center (SDDCs) can create an agile and scalable data center IT hardware infrastructure. These components include Software Defined Network (SDN), Software Defined Data Storage systems (SDS) and Software Defined Computing (SDC). Virtualized server, data storage and network routing hardware has revolutionized data center IT hardware allocations by enabling the efficient utilization of server/data storage resources – a practice which allows underutilized and idle server/storage demands to be load balanced, or dynamically reallocated to devices internal to the data center or another location. By reducing the total number of servers/storage systems operating, we can minimize overall IT physical infrastructure demand within the data center. The reduction of the total number of IT systems (network, server, and storage devices) decreases the amount of heat generated by this equipment, and in time diminishes the electrical and cooling requirements.

Server, storage, and network virtualization allows for the optimization of the physical hardware through the use of dynamic resource allocations capabilities of the computing resources. Adjusting the operations of the IT equipment based on true demand avoids overprovisioning of equipment and thus reducing energy waste.

Deploying power management features, such as power capping, inherent within the server, storage, and networking the virtualization software platforms allows the IT Manger to automatically power off, or idle servers, network, and storage hardware when not in demand – and dynamically reroute applications. The software will also allow the operator to preconfigure and cap the overall data center power and cooling consumption. Dynamically reallocating IT application demand, during peak energy consumption hours, offers the data center operators the ability to consolidate their infrastructure. This reduces the facilities overall electrical and cooling requirements, thus greatly reducing overall or time-of-day energy consumption.

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DCIM controlled power capping can be especially useful; this approach avoids power availability and cooling capacity constraints by prioritizing power allocation to critical systems, assisting in the control of overall energy costs and preventing thermal overload or outages within the data center. When administrators cap the total electrical usage of a facility, the automatic reallocation of IT demand to another internal or external infrastructure would be triggered once the threshold is met – controlling demand, electrical and cooling loads.

Convergence of the Information and Operational Technology (OT) platforms onto an IP based Ethernet platform (Layer 3) enhances the software consolidation capabilities of IT and facilities control systems. Operating on a shared communications platform allows the various systems to utilize a common IT podium to integrate monitoring and mitigation abilities for both IT and facilities system failures, reducing security risks.

In conjunction with the implementation of an optimization strategy, the purchase and use of energy saving equipment components such as high efficiency power supplies, fans and solid-state storage should be a key component. Right sizing servers and data storage systems for optimal virtualization allows the hardware to scale either vertically (internally) and horizontally (geographically) to meet the demands of the application without overprovisioning. Utilizing horizontal demand allocation capabilities will require planning to ensure the data transmission media is capable of meeting any data synchronization or latency challenges.

In larger facilities, the use of higher voltage component power supplies (415/480v) could reduce the need for additional electrical supply transformation, thus reducing energy waste and heat generation within the server hall. The use of the higher voltage 480V circuits also reduces resistive I2R (copper) losses by a factor of four to five times compared to using 240V or 208V circuits. This is due to 480V circuits requiring less current to deliver the same amount of power thus reducing resistive heat generation. This approach is evidenced in the following research paper, Improving High Performance Computing Efficiency with 480V Power Supplies, by Giri Chukkapalli & Maria McLaughlin, Cray Inc. 2013. Combined with the use of power capping, the higher voltage would offer greater savings while maintaining optimal systems performance.

With the importance of real-time access to data, digital application managers are continually looking for ways to improve performance. At times, application managers oversize the Random Access to Independent Disk (RAID) storage configurations. Reanalyzing the need for RAID 5 configurations to utilize less demanding storage will reduce the overall storage capacity needed to meet the demand requirements, improve responsiveness of data access, and lessen the overprovisioning storage systems.

Implementing Solid-State Disks (SSDs) either within the server or an independent data storage array in the facility offers considerable energy consumption savings by reducing the heat generated within equipment. Although more expensive, the improved capabilities of SSD increase performance while reducing the overall carbon footprint of the equipment.

OPTIMIZING INFORMATION AND OPERATIONAL TECHNOLOGY

Three server rack cooling strategies have become a conventional implementation in today's data centers. By separating the hot and cold air streams, physical aisle containment deployments minimize the mixture of hot and cold air, preventing hot spots and reducing energy waste. This approach provides the operations managers more precise control of cooling, improves equipment performance, and extends the life cycle of the equipment.

Hot aisle containment keeps equipment exhaust from mixing with the cool air by deploying physical barriers to keep the warm air contained and route the air to the cooling units. This containment strategy introduces an issue for operators or maintenance staff who must work in a warm environment that can exceed 100 degrees Fahrenheit. Local and federal employee working environments requirements should be closely followed.

Cold aisle containment is less popular, yet remarkably similar to hot aisle containment, only holding the cold air the servers consume. However, in the event of catastrophic cooling failure, servers can overheat very quickly causing a total system failure. Deployment of a cold aisle only containment strategy introduces unnecessary operational risk. Instead, this should be a component of an overall optimization strategy.

With the advancement of real time Artificial Intelligence (AI) predictive analysis capabilities, operators can utilize this information to manage their risk more efficiently. A consolidated IT and operational systems optimization strategy will introduce the option to use an advanced containment cooling strategy. This is widespread practice to install either a hot or a cold aisle containment strategy.

Deploying a combined hot and cold aisle rack infrastructure cooling strategy offers the greatest opportunity for energy savings yet introduces risk to the server infrastructure; in the event of a cooling, either water or refrigerant based systems failure, servers would quickly consume the existing contained cool air and result in a catastrophic hardware system failure. However, as a component of a holistic facilities and IT infrastructure redeployment strategy, this risk can be mitigated.

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CONCLUSION

Developing a server and IT hardware consolidation plan requires careful planning to ensure data synchronization, latency, security, and systems redundancy requirements are contemplated. Considering workload distribution, virtual server settings, facilities interconnectivity speeds, and overall power management policies is crucial. Continued, regular monitoring and analysis will be necessary to adapt changing workloads and application requirements in the effort to strike a balance between power efficiency and the optimal performance of the critical systems.

Data centers manage critical and sensitive information, making security a critical factor in optimization efforts. Convergence of the DCIM, IT and OT networks onto a single platform requires careful planning and continually monitoring. Efficient real-time monitoring and analytics are critical for identifying potential security issues, optimizing resources and performance bottlenecks predicting failures.

Insights and guidance in the development of a holistic strategy can be gained by continued exploration of the various aspects of data center optimization outlined in this paper. A more informed understanding and implementation of integrated strategies will lead to improved efficiencies, systems performance, redundancy, and the overall reduction of power consumption.

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Chad Harrill is Mission Critical Facilities Project Manager at HDR. He can be reached at chad.harrill@hdrinc.com.

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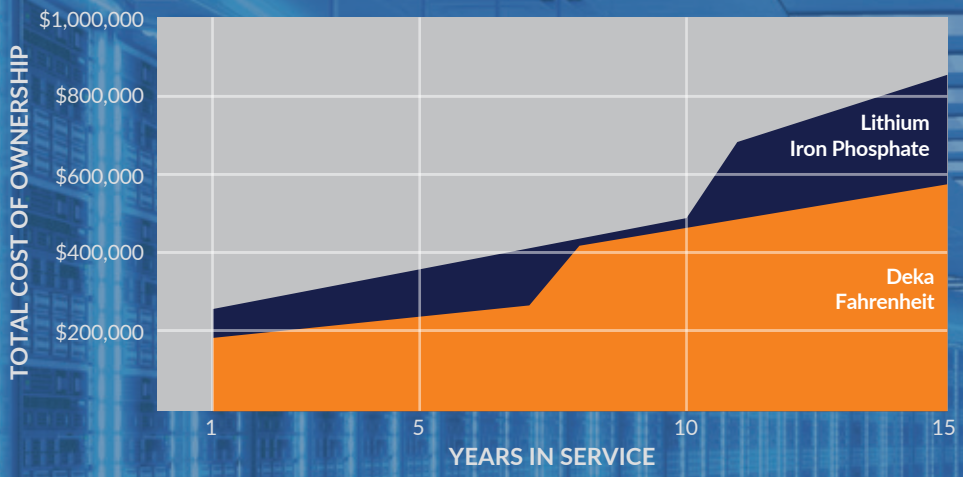

Data Center TCO Analysis Factors 1 MW System

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	Lithium Iron Phosphate 10-yr Warranty	Deka Fahrenheit 7-yr Warranty
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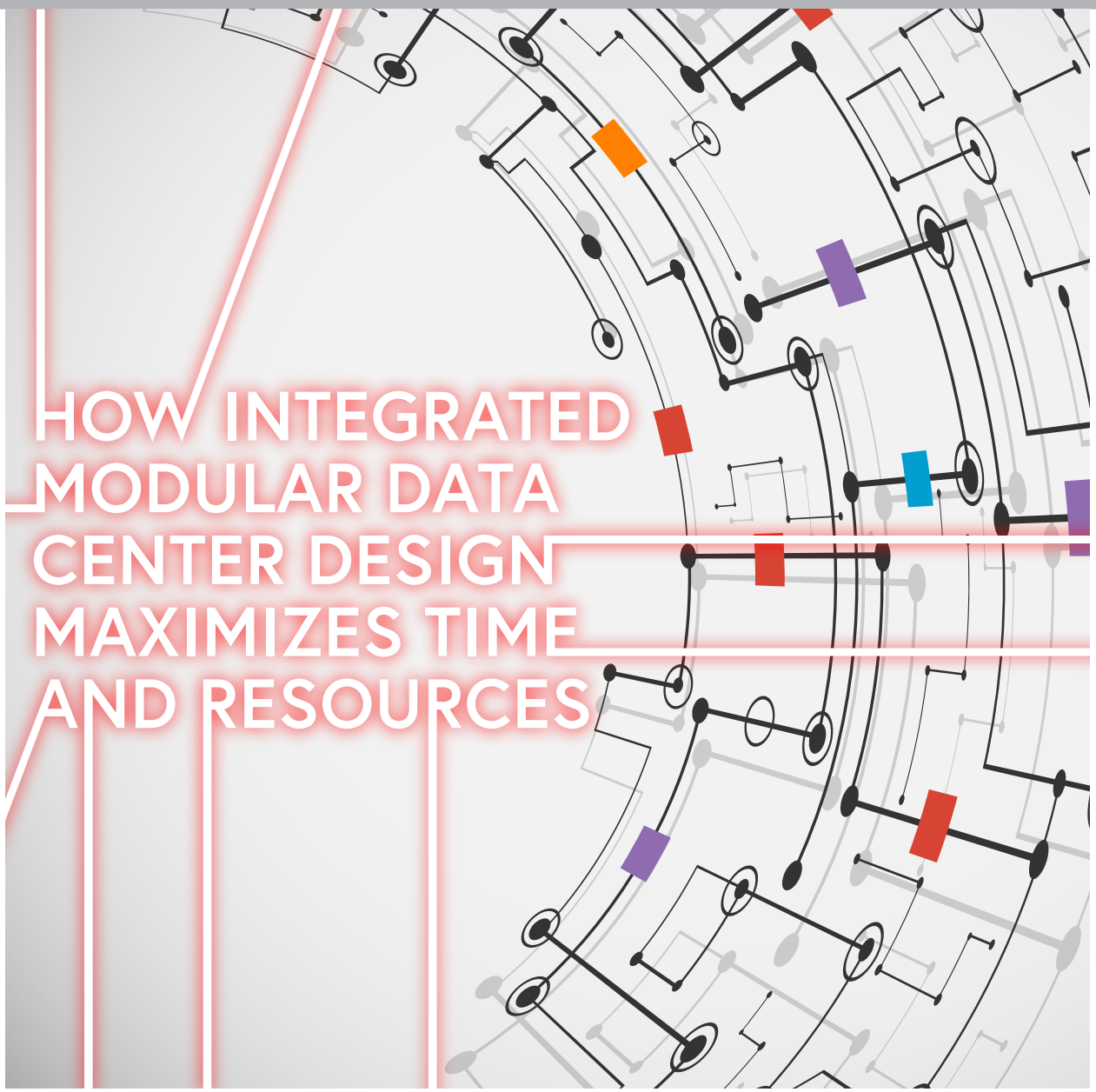

HOW INTEGRATED MODULAR DATA CENTER DESIGN MAXIMIZES TIME AND RESOURCES

by Dutch Wickes
Matt Lamont

The words "modular data center" create many different images in peoples' minds. Some might visualize an equipment skid with individual components assembled off-site, which is then transported to a conventional building and put into place. Others may picture a full IT module with cooling racks, built off-site and placed into a yard with power infrastructure.

Regardless of the mental image they conjure, modular data centers consistently lead to major benefits over conventional construction projects including high-quality installation, minimal on-site work, and scalable and replicable solutions. Perhaps most importantly, modular data centers can maximize speed to market and be extremely cost-effective for clients and project teams.

The HKS Mission Critical team, which has many years of experience designing and delivering modular data centers, recently had the opportunity to maximize all these benefits while working on the SoFi Stadium Modular DAS Data Center in Inglewood, California.

A Major Challenge

This project presented a major challenge: our client needed a 13,000 square foot data center to support a Distributed Antenna System and host four carriers. Adding to the challenge was a mandate that procurement, design, local approval, fabrication, delivery and full operational capability all

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take place within nine months. The team got to work immediately and made sure to involve all design disciplines, modular manufacturer TAS, the construction manager, and client representatives to facilitate real-time decision making and approvals.

We didn't follow the typical approach of having one design discipline work to a certain level of completion before passing the project to the next discipline. All players were at the table throughout the process. We completed the design during a one-day work session, followed up with concept and schematic design, and kept lines of communication open during twice-weekly coordination sessions. At the end of that first day, an HKS project manager declared that the project was akin to a rocket being launched — after lift-off, there was no turning back and no slowing of the pace.

In addition to being a fantastic example of teamwork and fast-paced, integrated decision making, the SoFi Stadium Modular DAS Data Center features a best-in-class design that is scalable and replicable. It has 30 modules designed at standardized sizes for simplified manufacturing and transport to the project site from the fabrication and assembly facility in Houston, Texas.

The data center has white space modules for telecom equipment and grey space modules for mechanical and electrical equipment. Modules arrived with MEP systems already designed and installed and came pre-certified with UL labels, which reduced work time and inspection requirements at the site. The team also chose to have the hollow metal doors and frames between white space and grey space modules assembled in the controlled factory environment — everything from door hardware to exit lights and signage was installed in Houston prior to shipment to Southern California. Today, the DAS modular assembly and all critical equipment are contained within a screened perimeter wall, affording a secure environment to critical operations, and effectively sequestering those operations from the public environment at SoFi Stadium and Hollywood Park.

Lowering Costs and Adding Value

There are many ways modular data center design and construction can reduce costs compared to traditional construction. Once an appropriate module is created, it's relatively simple to repeat the process and lower costly material and labor expenses. Like an assembly line, off-site module creation maximizes budget efficiency. Cross-trained professionals at the manufacturing plant who build modules take the place of a variety of tradespeople and countless assembly hours at the job site. Additionally, off-site module manufacturing can happen at the same time as job site preparations, so construction timelines and associated costs are reduced.

With the SoFi Stadium Modular DAS Data Center, all these cost benefits paid handsome dividends. The initial one-day work session resulted in a rough order-of-magnitude budget for the project, and the project team worked closely with the client ownership group to adequately communicate and work through changes as the project progressed. TAS' Houston manufacturing plant was large enough that it could assemble and house most modules concurrently, leading to significant time and cost savings. The modular solution led to seamless installation at the site with fewer tradespeople and greater organization than traditional construction, which allowed the project to meet its ambitious schedule without financial strain.

Successful outcomes at SoFi Stadium Modular DAS Data Center were only possible because the project was championed by a client that staffed a team of professionals at the top of their game and was willing to put trust in the hands of dedicated designers and manufacturers to deliver it. Because of that trust and our ability to collaborate in a talent-rich environment, our HKS team was able to meet the short timeline, save money and create a facility capable of handling a high volume of data for the NFL's largest stadium.

Dutch Wickes is Global Practice Director, Mission Critical, and a Principal at HKS. He can be reached at dwickes@hksinc.com.

Matt Lamont is Practice Leader, Mission Critical and a Principal at HKS. He can be reached at mlamont@hksinc.com.

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by Gary Balash

WHAT ARE ENGINEERED ALLOYS?

Before a battery grid is even created, a decision must be made on the raw materials. Most battery companies use a lead alloy with a concentration of lead close to 99%. Despite the novel buzz words which fill the market like "Pure Lead" or "Thin Plate Pure Lead (TPPL)," pure lead has been around for a long time. By itself, this chemistry is not particularly beneficial to the end-user, and can potentially result in poor performance and life. In fact, a battery with 100% pure lead can impede charge acceptance through the gradual buildup of a passivation layer, affecting the mass-to-grid interface[1,2].

What is most beneficial is an engineered blend of lead and other elements (an alloy) to match the battery's intended service needs.

Based on industry papers, research, and results, optimized performance and long life in high-rate applications occurs with a perfected mixture of superior quality lead with tin and calcium,[2, 3, 4] not solely with just pure lead. It is a composition using an engineered alloy formula with high lead purity, specifically tailored to meet the proper high-rate application that improves the mass-to-grid interface's conductivity.

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An enhanced mass-to-grid interface allows for greater adhesion and uniformity of active material contact, optimizing the battery's power delivery and improving life compared to a strictly pure lead/TPPL battery. This engineered alloy also provides increased corrosion tolerance, conductive performance, manufacturing consistency, and proven performance that a pure lead and TPPL grid solution cannot match.

WHAT IS COMPU-PRESS®?

Compu-Press is a process that produces an optimized battery grid ideal for high-rate applications. The core of this proven process is rolling metal to enhance its strength beyond its original state. Compu-Press casts a thick, continuous solid sheet of engineered alloyed lead, and rolls it under multiple stages of extreme pressure, and compresses that sheet down to a computer-controlled optimally designed thickness.

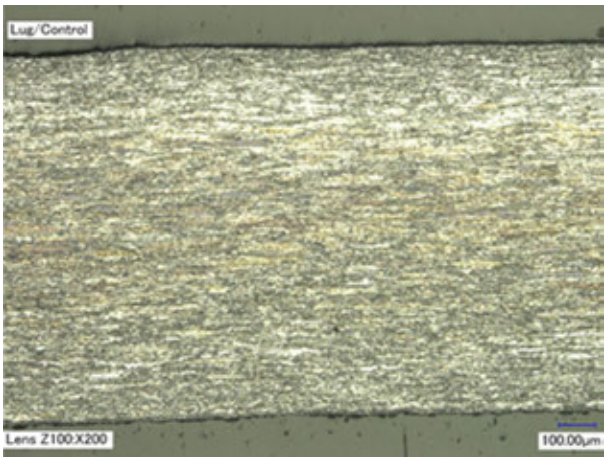
Once compressed, it is ultimately perforated into a highly compacted, robust grid. It is similar to a cold-rolled steel process. In terms of physical characteristics, cold-rolled steels are typically harder and stronger than standard hot-rolled steels. As the metal is shaped at the lower temperatures, the steel's hardness, resistance against tension breaking, and resistance against deformation is increased[5].

The Compu-Press process, in combination with an engineered alloy formula, produces high quality grids, featuring an excellent combination of mechanical properties such as improved tensile strength, shear strength, toughness, and hardness. Compared to pure lead/TPPL, lead alloyed with high tin, and low calcium is over 390% stronger in Ultimate Tensile Strength. This increased strength helps prevent active material shedding.

The Compu-Press process changes the original materials' morphology into a homogeneous grain structure, solidifying it for high-rate performance rigors. A finished Compu-Press grid creates an elongated grain structure with a visual appearance similar to layers of armor (Fig. 1). The outer layers limit the electrolyte's path to the grid's outer surface, protecting the grid's inner layers and core. Should corrosion affect the outer layer, there are multiple layers of protection still in place.

As with any lead battery, corrosion of the grid by the electrolyte occurs along the grain boundary edges. With its horizontal layers of armor, any pathways for the electrolyte to penetrate the Compu-Press grid grain boundary edges are similar to a labyrinth, making it virtually impassable.

(Figure 1)



The beneficial effects of high tin on positive-grid corrosion in VRLA batteries improve corrosion resistance because of the large number of fine precipitate particles and better accommodation of the stresses of corrosion by the high mechanical properties of the alloys.[4]

– R. DAVID PRENGAMAN

WHAT IS HYDRO-FORMATION?

After the grids are created and pasted with proprietary lead-oxide paste, they become plates. After plates are cured using exacting methods, they are inserted into battery cases, assembled, and are ready for the Hydro-Formation process. As a manufacturing process, the formation step is critical to provide the battery energy for long life and performance. As is common practice, the step of formation involves a very carefully calculated process that takes a prescribed amount of time to form out the battery plates with high amounts of electricity, producing heat as a byproduct.

Hydro-Formation uses a highly technical computer-controlled process of chilled water-assisted formation throughout its proprietary process. This process enables a more consistent and efficient formation of the entire battery by controlling its overall temperature throughout the entire process, resulting in significant productivity efficiencies and energy savings.

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Additionally, all Deka batteries, including the new Deka HRC are virtually 100% sustainable and offer a financial credit when they reach end of life. Compared to alternative technologies such as lithium, Deka batteries provide high reliability and the lowest overall Total Cost of Ownership (TCO).

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SOURCES:

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5. *Hot Rolled vs. Cold Rolled Steel Blog - reliancefoundry.com*

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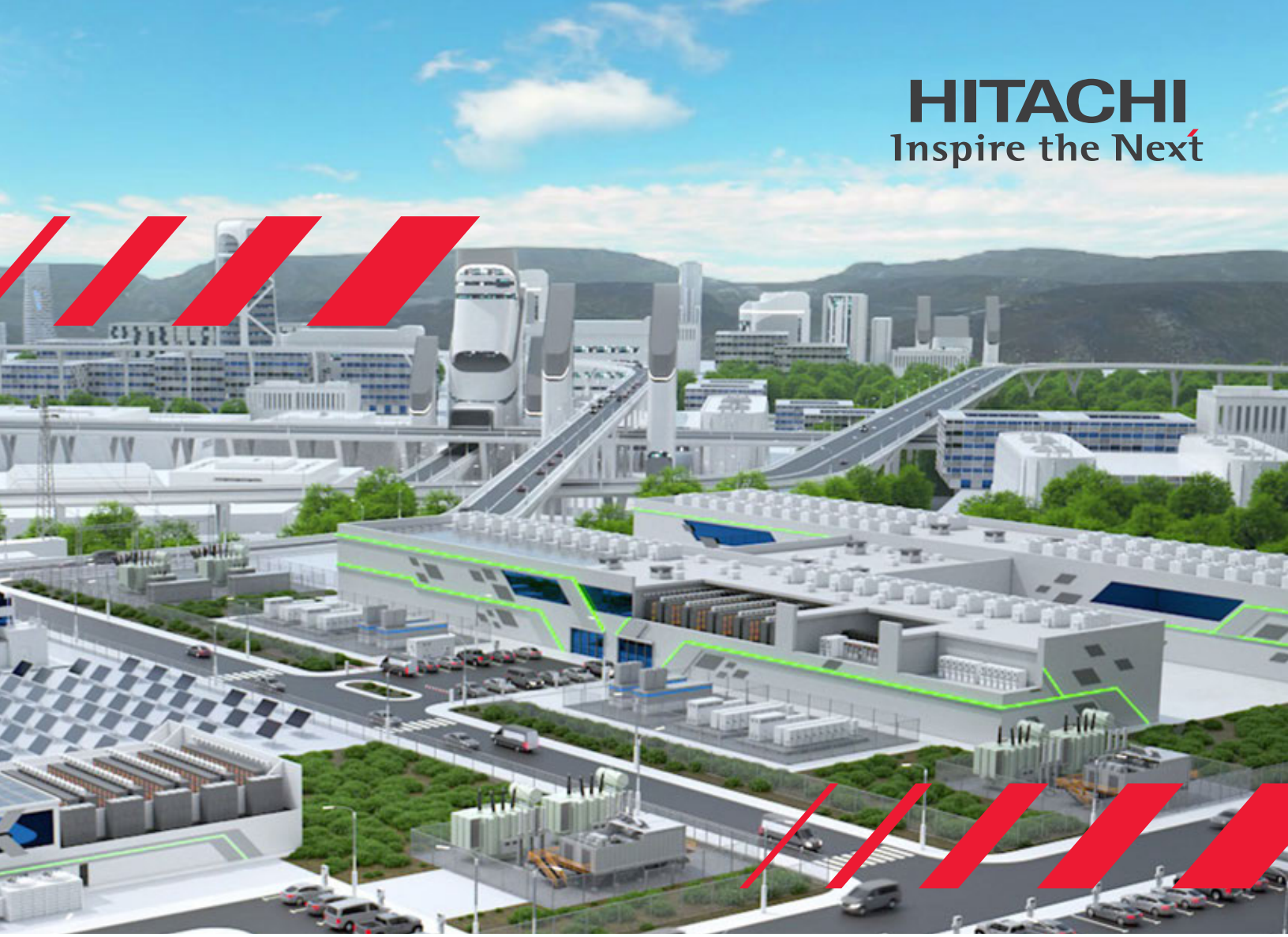

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ENERGY EFFICIENCY AND POWER SOLUTIONS IN DATA CENTERS

by Cameron Wynne

Equipment and infrastructure modernization is critical to running an efficient data center. The IT industry and computing demands are evolving rapidly alongside efforts to achieve greater sustainability. The growth of the data center industry has also begun to exceed the power generation industry – a convergence that means data center engineers need to do more with less, giving efficiency a center-stage focus.

Businesses seeking to remain agile in this landscape must prioritize addressing operational performance in their data centers. These efforts include implementing technology to achieve measurable impacts to performance, cost, and energy utilization, as well as meeting the rising challenge of denser computing environments.

Data centers are among the highest consumers of electric power. IT systems – computer servers, data storage, and networking – consume the bulk of the power, and all that power is turned into heat. The most power-hungry non-IT component of the data center is the cooling system which maintains the IT equipment at their ideal temperatures.

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Data center power and design features are susceptible to aging – both from the equipment's ability to function optimally and when emerging technology renders prior technology obsolete. An intelligent combination of design and innovative technology is needed to reduce power consumption, more efficiently utilize power drawn, and eventually reach net zero emissions. Data center engineers can benefit significantly from updating their design architectures and evaluating how industry advancements are leveraged to reduce energy consumption and improve cooling efficiency.

Power

Power Usage Effectiveness (PUE) consumption performance is a helpful measurement used to determine how efficiently the data center uses its power resources. PUE is the ratio of the data center's overall load to the IT equipment's critical load. A lower PUE has a host of benefits: the data center is more efficient, makes the best use of its power without wasting resources, and costs less to operate. From a profitability standpoint, lowering the PUE also allows for even more IT equipment for the same power.

Lowering PUE doesn't happen from one singular approach. Data center engineers integrate numerous techniques while continually monitoring and analyzing data to provide both large-scale and minute adjustments, improving their facility's PUE. Balancing cooling reliance and improving containment strategies are examples of these techniques that contribute to better energy management. Yet when it comes to older data centers, purchasing and installing new and more modern equipment can remediate inefficiencies and decrease power waste in surprising ways.

Cooling Via Fans

Today's IT equipment and servers run at very high temperatures, putting them at risk of overheating and failing. Data centers are designed to maintain an optimally cooled environment to minimize the IT equipment failure rate. Computer Room Air Handlers (CRAHs) blow cold air, pressurizing the space under raised data center access floors. Perforated tiles in the floor in front of each cabinet selectively direct the cold air to the front of the IT equipment.

While the data hall under floor cooling has mostly stayed the same in recent years, expert technicians can make measurable efficiency gains by utilizing fan speeds to reduce energy consumption in the data center. For example, fans inside a CRAH unit, running at 100%, will use approximately five times the power of the same CRAH unit with fans running at 50%.

By adding more CRAHs with modulated fans, engineers can reduce their fan speeds and gain considerable power savings. When delivered at scale across the data center, these exacting calibrations improve PUE and measurably reduce the total power necessary to cool the data center.

Cooling Via Water

Water temperatures can be altered to reduce energy consumption, as well. Closed-loop water systems deliver cold water to CRAHs, resulting in cold forced air. Calibrating systems to handle temperature differences and fluctuations is essential to cooling efficiency.

Data center design engineers and data center operators work together to evaluate the weather characteristics of the data center location, the air temperature to be supplied to the critical IT equipment, as well as chiller and CRAH configuration. Optimizing the system as a whole leads to the ideal chilled water temperature, which will use the least energy for the least construction cost while providing all the cold air that the critical IT equipment will need.

Additional efficiency can be created by maximizing both air and water differential temperatures. Higher chilled water temperatures increases efficiency and reduces power usage on a bigger scale. Managing all equipment thresholds and implementing efficiency measures avoids over-cooling – a best practice for data center operations.

High energy consumption continues to be an issue in the data center, but organizations are moving to more energy-efficient systems to manage and reduce their power usage. By calibrating equipment, upgrading the data center with CRAH units to provide speed-variable fans for increased efficiency, and calibrating the adjusted chilled water temperature to be in line with American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standards will help data centers become more efficient and save electricity usage.

Cameron Wynne is Chief Data Center Officer at Element Critical. He can be reached at cwynne@elementcritical.com.

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Optimizing IT Change Management for UPSTREAM SERVICE DELIVERY

by Yousef AlSuwaidan
Anwar Ayub
Abdullah Aldhamin

EXECUTIVE SUMMARY

IT Change Management is a core process for IT operations in the oil and gas industry as changes to systems could impede real-time drilling and exploration activities, and may lead to cascading implications. Managing change is further complicated given the complex and disperse operations for oil and gas companies typically spanning multiple data centers, user locations, and geographically dispersed operational areas. Given the importance and criticality of this process, it has been known to be a risk-averse and deliberate process to avoid any potential disruptions to the 24x7 time-sensitive operations. However, this rigid approach is not streamlined with modern IT technologies and practices, such as, Continuous Integration/Continuous Deployment (CI/CD) pipelines for DevOps, cloud computing, and Software Defined Networking (SDN) that are characterized by rapid small changes.

More importantly, the digital transformation is revolutionizing the oil and gas in an unprecedented pace in the history of the industry. As a result, this elevates the challenge for IT operations in this industry to cater for the aforementioned emerging necessities, while at the same time continuing to provide close oversight and review of associated risk and impact. Proper categorization of change activities, accurate change assessments, enhanced communication plans, and simplified approval workflows results in a framework that supports rapid delivery of IT changes and still mitigate the potential risks associated with these changes.

METHODOLOGY

The main motivations behind optimizing the IT Change Management process is to simplify the process, reduce lead time for implementing routine changes, and avail the needed focus on high risk and impact activities, or new activities. Previously, there was a lack of clarity over the implementation and impact of change requests resulting in some changes going through multiple reviews and approval stages. Hence, major changes occasionally were either delayed or rushed, which has created an overhead for both support and business users alike.

To achieve these objectives, a project-based taskforce was established to work on three frontiers: data collection, analysis, and process policy documents update. First, data about the IT Change Management process practices was collected and reviewed. During that, a survey was conducted with the stakeholders as an input for the analysis. Next, structured analysis was conducted to identify and prioritize key pain points. In other words, a thorough historical changes review was conducted that involved analyzing different types of change activities along with the tasks associated with these change activities.

This analysis determined that proper change planning and assessments would alleviate the consistency issues with processing major changes. Therefore, the process enhancements focused on improving the initial change planning and assessment phases in order to streamline the downstream approval, scheduling, and implementation phases. Finally, in order to achieve user and customer buy-in, the revised policy and process documents were reviewed and signed by all key stakeholders.

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IT CHANGE MANAGEMENT ENHANCEMENTS

Identifying and Categorizing Change Activities

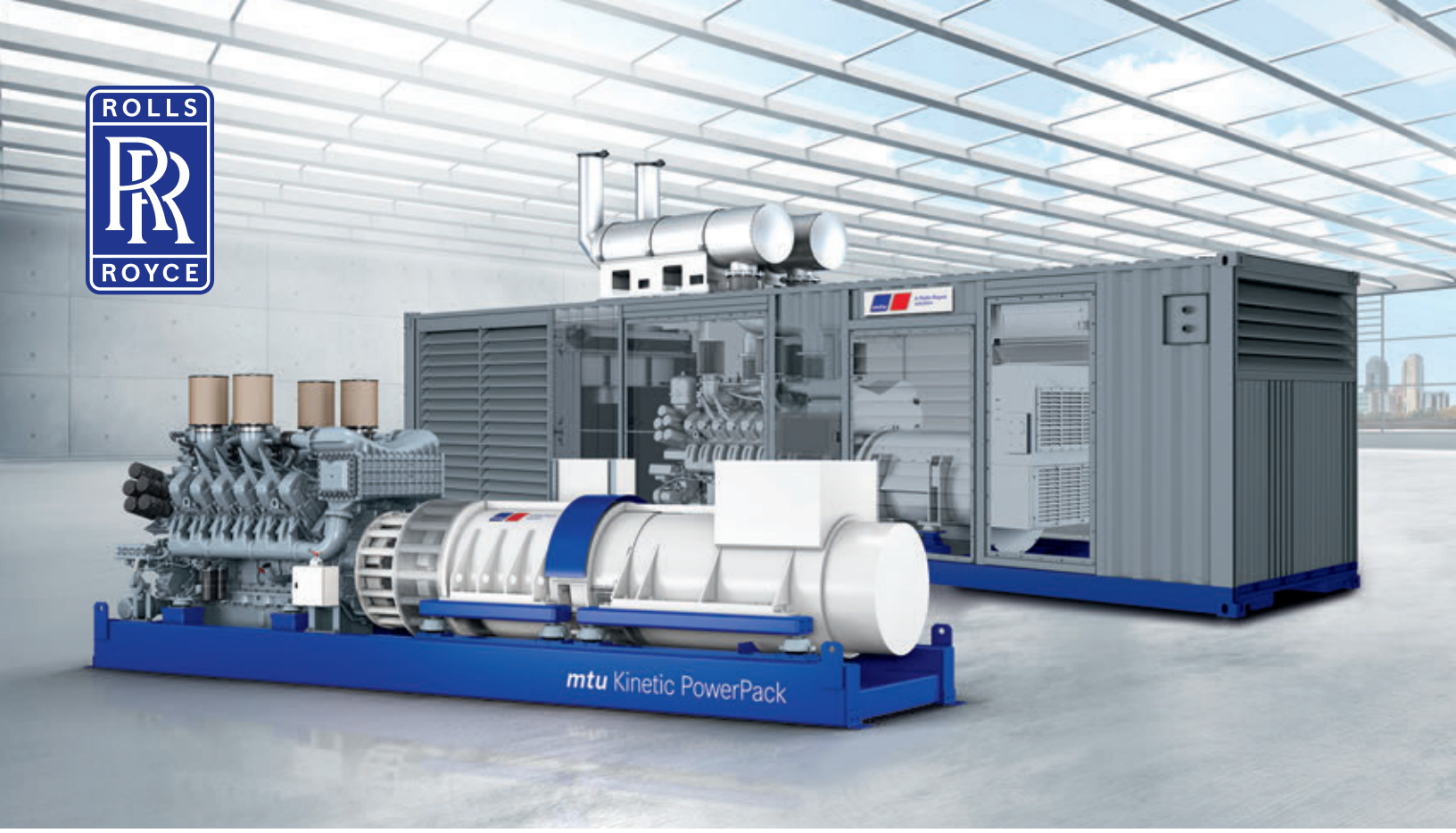
The first step of developing the new framework was to understand the type and nature of changes implemented in the environment. This was done by performing historical analysis of changes and working with support groups to understand their changes. The analysis provided insight into the risk, impact, and frequency of change activities. Based on this information, required resources, standard deployment times, and outage windows, authorization and communication requirements were identified for change activities. Segregating the known activities based on their potential impact and history expedites the implementation of routine, low risk and impact activities while ensuring that IT Change Management time and resources are dedicated to high risk and impact changes.

VALUE STREAM MAPPING APPROVAL FOR CHANGE ACTIVITIES

A standard, global change window for all changes does not align with the evolving needs of the business users. Different business priorities and objectives made it challenging to schedule IT changes. As part of the change activity analysis, IT Change Management identified the services and users affected for each change activity using the Value Stream Mapping (VSM) methodology. VSM is a practice based upon Lean management principles to visualize the flow of work, information, and services required to deliver services to users. One of the primary benefits of VSM is identifying inefficiencies in service delivery.

VSM reduces the review and processing overhead with evaluating change request. Instead of a global Change Advisory Board (CAB) reviewing all changes and trying to fit the changes into a single maintenance window, the VSM allows routing the approval and scheduling of IT changes only to the business entities affected by the activity. Consequently, change authorities across the organization are likely to spend more time analyzing these targeted changes for approval, as compared to the previous practice. As formerly they would receive a larger volume of changes, many of which did not affect their area of concern.

Since these changes have a defined and known impact, they can also be scheduled at any time and do not need to be included as part of the standard maintenance window. This allows for greater flexibility for the business users in the scheduling and implementation of IT changes in alignment with their current business requirements. It also enables IT support to implement changes faster rather than waiting for the weekly maintenance window.



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SYSTEMIZING THE RISK AND IMPACT ASSESSMENTS

Risk and impact assessments are key parts of a Change Request as the result of these assessment determine the level of approval and lead time for a change activity. Therefore, it is important to have a consistent, repeatable assessment for all changes. The updated IT Change Management introduced a systematic approach to determine the associated risk and impact level of a change activity. The assessments consist of a set of weighted questions that are captured as part of the creation of a Change Request. This makes it easier for the process managers to review Change Requests and gauge the overall risk and impact without the need to involve other Subject Matter Experts in the evaluation. It also facilitates the historical review of similar changes.

COMMUNICATION PLANS

Although users do not need to be informed of all changes implemented in IT services, they do need to be informed about instances where the change activity will or may cause service disruption or require some action from the users. The revised IT Change Management process requires developing the communication plan as part of the implementation task for high risk and impact changes to ensure that the necessary details about a change are communicated in a timely manner to the relevant users and support groups. Making the communication plan a requirement results in closer communication across IT support groups and users which helps identify potential roadblocks ahead of time. The result is that business users now have more lead time to adjust their plans to accommodate for IT changes.

INTEGRATION WITH DEVOPS CI/CD PIPELINES

Traditional IT Change Management requires documenting, reviewing, approving, and scheduling all change requests. Given the volume and frequent changes in DevOps and cloud services, this practice becomes impractical and burdensome on support groups. Integrating the IT Change Management system with CI/CD orchestration tools will enable automating the various steps of a traditional change request from creation, approval, to closure via APIs or web services. The introduced enhancements provide the required flexibility from both a technology and process perspective that facilitates the continuous and rapid changes that are characteristic of CI/CD pipelines.

CONCLUSION

Oil and gas IT operations rely on an effective IT Change Management process to minimize the downtime and impact on operations and users. Due to the sensitivity and criticality of oil and gas drilling and exploration services, service disruptions must be minimized. IT Change Management oversees a complex environment spanning multiple datacenters, user area buildings, and IT support groups.

The traditional practice of evaluating all changes during a weekly CAB meeting does not align with the increasing volume and frequency of changes related to IT systems and applications. Therefore, the updated IT Change Management framework streamlined the processing of changes while still ensuring that high risk and impact changes are adequately reviewed and approved to reduce the impact on 24x7 operations and users

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ACCELERATING DIGITAL INFRASTRUCTURE IN THE SOUTHEAST

by Melissa Reali Elliott

The Southeast United States is quickly becoming a point of interest for digital infrastructure builders with an eye for future development. As demonstrated by their explosive population growth, many cities up the East coast are known for their exceptional economic climate and superior quality of life, combined with a dynamic, educated workforce and abundant resources. As businesses invest to grow their Southeast operations, there is a growing need to accelerate digital infrastructure. By tuning in to digital trends, digital operators, especially hyperscalers, are quick to identify emerging needs in order to stay ahead of shifting markets, bringing fresh infrastructure support for more business growth.

NO MAN IS AN ISLAND

The complexity to add new interconnected "nodes," increase bandwidth, reduce latency, and optimize network connectivity, means that data center operators are continuously searching for more capacity and additional routes to connect sites to the growing global ecosystem of digital providers. Future demands continue to emerge and evolve, accelerating the need for integrated digital infrastructure solutions that are interwoven to create a "fabric" of connectivity.

More than ever, data centers must provide connectivity for its services and to other operators. This means expanding access to and from their customers in all directions, in turn allowing them to provide service to any location, regardless of whether it's available in their own facility. By adding routes and access points to accommodate more service capabilities, digital integrators are building alternative pathways. The emphasis must be on fortifying this market to be able to provide digital enablement of any kind, which, given the rapid adoption of revolutionary technologies, such as AI, can change within months.

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operators and service providers due to its pivotal role in seamless communication and expanding reach. It empowers companies to extend their network coverage, reach new markets, and provide enhanced service offerings. Data centers in the Southeast with access to subsea cables and the newly constructed Myrtle Beach CLS will be a step ahead of the game, able to plug in to the interconnected global fabric that will contribute to network resiliency, increased access to global communications partners, and the engagement of international markets.

When looking at the traffic that will be generated from subsea cable operators, being able to connect to cloud and content service providers will play a crucial role in meeting the needs of the region. This can be achieved through developing a host of unique fiber routes to bolster regional connectivity and streamline operations. An expansion of diverse fiber routes also ensures that a business is protected from downtime due to man-made or natural disasters.

A customer should be able to go to any data center and have access to a broad connectivity ecosystem and a full stack of services all in one place. Data centers primed for the growth of activity must learn to interweave resilient and reliable colocation with international and regional connectivity to create a fabric of support and accelerate the digital infrastructure needs that are looming on the horizon.

HERE ENTERS THE NEED FOR MORE CABLE LANDING STATIONS

Building full digital integration to serve our ever-growing needs for connectivity, means we must prime regions by building new accessibility to the subsea cable network. Access to international markets through a cable landing station gives network operators a more comprehensive way to serve the entire region and fortifies opportunities for those that rely on digital infrastructure. According to TeleGeography, there are over 550 active and planned submarine cables currently underway around the world. Fiber-optic cables originating from the Southeastern coastline have the capability to extend to Europe, South America, and Africa.

The Southeast region is being brought up to par with leading international markets, making it a focal point in the future of digital infrastructure. Having access points for international connectivity increases the viability of multi-state — and beyond that, multi-market — reach in that area. With the example of our CLS in South Carolina, this new development removes the burden of routing through other more distant states like Florida for subsea connectivity.

As our increasingly digital world grows and global connectivity correspondingly accelerates, terrestrial network operators must start tackling what the next-generation of digital infrastructure will look like. The goal must be to think one step ahead.

Interconnected regions, like what DC BLOX is building in the Southeast, are preparing to serve as leading gateways for global businesses across continents. With this new data neural network, the coming years will see a boom of business that connects operations and opportunities from around the world together through vertically-integrated digital infrastructure.

Melissa Reali Elliott is Content Marketing Manager at DC BLOX. She can be reached at dcblox@imillerpr.com.

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POWER CABLES – YOU GOTTA KNOW HOW TO HOLD 'EM

by Jamie Hughes

Conduit and wire systems have been the default installation method throughout the USA for many, many years, however, the use of flexible cable installations is rapidly increasing throughout industry, including Data Centers, which provides users with an array of options for their particular applications.

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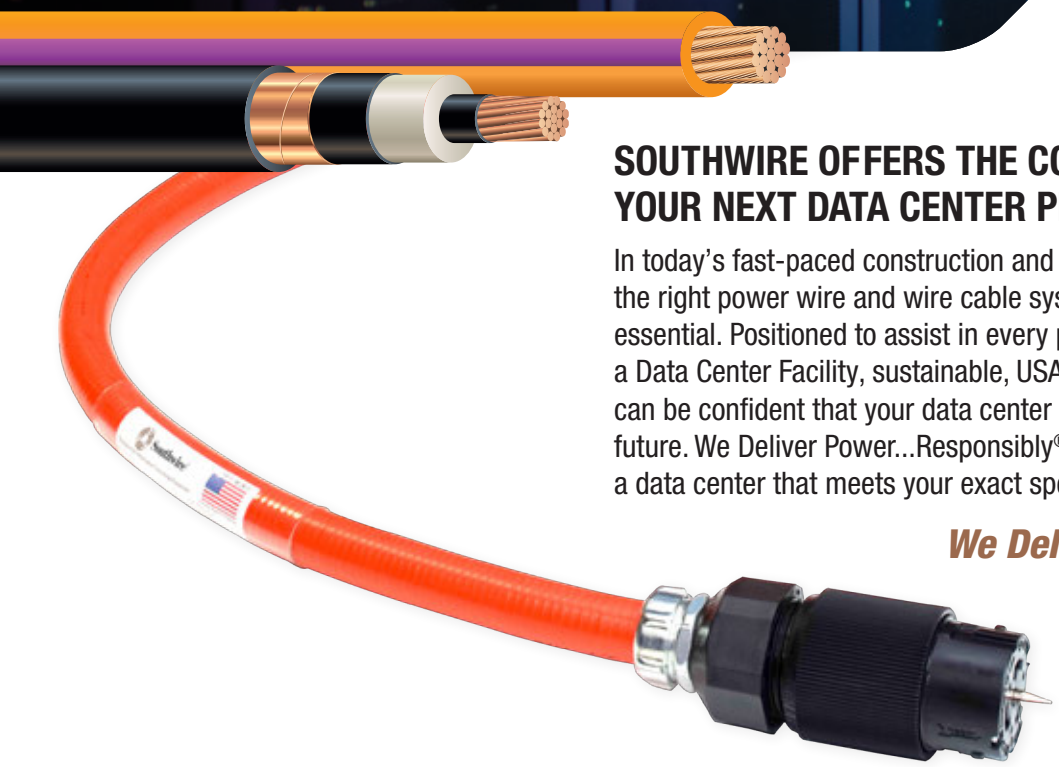

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Flexible cables are typically installed on cable tray systems or cable hangers and need to be secured effectively. Industry simply defaulted to the use of cable ties or bands (metallic and non-metallic) to perform this task, however, if not installed correctly, they can cause considerable damage to the cable sheath due to cable movement under normal thermal cycling.

Examples;

Thermal Cycle Chafing

Engineers, Designers and Installers should therefore select a cable restraint method capable of both securing and protecting the cable; preferably a product designed and tested for this purpose, such as a Cable Cleat, which are commonly used throughout industry where flexible cable systems have been employed for decades.

Examples:

Single Bolt Cleat

Double Bolt Cleat

3 PHASE SINGLE CONDUCTOR POWER CABLES

With the increasing power demand in Data Centers, single conductor power cables may be the ideal solution for your particular application. However, extreme care is needed when installing 3 phase single conductor cables, to ensure the cables are protected during normal and fault conditions. Unfortunately, there is very little guidance provided in NFPA 70 for such installations. Article 392.20 (C) simply states that cables should be;

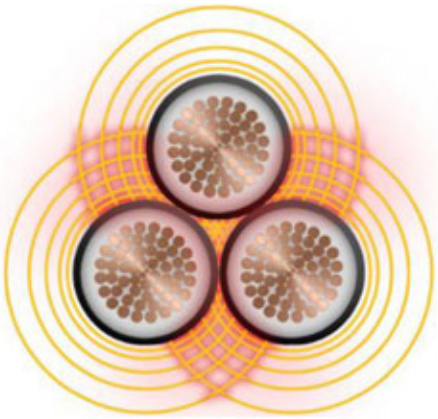
'bound in circuit groups to prevent excessive movement due to fault current magnetic forces'

However, this doesn't really address the issue.

The common installation method is to run the cables in a Trefoil formation, which balances the electromechanical field and heating effect, with zero or minimal voltage drop, resulting in the cables being used to their full potential.

TREFOIL FORMATION

Cables installed in a Trefoil formation need to be secured with a restraining device capable of withstanding any fault generated, electromechanical forces, which can be extreme in nature.

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WHAT IS THE SOLUTION?

With limited guidance in NFPA 70, industry has turned to IEC 61914 (Cable Cleats for Electrical Installations) for guidance. This standard was introduced back in 2009 and has become the default standard for cable cleats in today's global market. IEC 61914 provides a range of test methods, including; Impact, Axial and Lateral load to secure and restrain the cables and then provides methods to calculate the fault generated forces followed by a series of short circuit test requirements for Cable Cleats.

WHY USE A CABLE CLEAT?

The purpose of a cable cleat is to support the cable so it is not in direct contact with any other surface. Cable cleats must be sufficiently strong to support the weight of the cable, prevent slippage without damaging the cable, be able to withstand declared impact, lateral and axial load levels, and where necessary, withstand a declared Short Circuit Current (SCC) based upon a detailed test specification as defined in IEC 61914.

THE FORCE IS STRONG

IEC 61914 provides a simple equation to calculate the potential fault generated electro-mechanical force:

$$Ft = \frac{0.17 \times ip^2}{S}$$

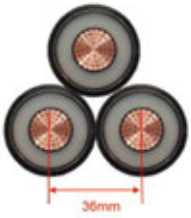
where;

Ft – is the maximum force on the cable (N/m)

ip – is the peak short circuit current (kA)

S – is the center to center distance between two neighboring conductors (m)

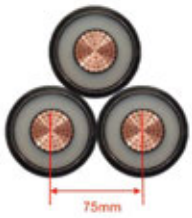
Example 1 – Trefoil Formation – 36mm (1.42")



Max Peak Fault Current – 60kA, Cable Diameter – 36mm (1.42")

$Ft = \frac{0.17 \times 60^2}{0.036}$ = 17,000 Newtons per meter = **1.7 Ton-force per meter**

Example 2 – Trefoil Formation – 75mm (2.95")



Max Peak Fault Current – 60kA, Cable Diameter – 75mm (2.95")

$Ft = \frac{0.17 \times 60^2}{0.075}$ = 8,160 Newtons per meter = **0.83 Ton-force per meter**

As can be seen from above, the larger the cable i.e. center-to-center distance of two conductors, the lower the force.

Note: IEC 61914 requires that all LV short circuit tests on cable cleats are conducted on cables between 30-40mm or 45-55mm in diameter.

Once the maximum prospective force from a short circuit is known, suitable cable cleats, tested to IEC 61914 can then be selected to provide a Secure, Safe, Installation.

So…now you know how to Hold 'Em…

Jamie Hughes is Americas Regional Manager at CMP Products.
Jamie can be reached at jamie.hughes@cmp-products.com.

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by Brian Kennedy

Mission-critical facilities may not run on batteries, but they depend on them. For industries represented in the 7x24 Exchange International membership – aerospace, healthcare, manufacturing, technology, and more – even a momentary power loss can cost money and impact lives. This is why an uninterruptible power supply (UPS) system, with batteries acting as the bridge between utility power and generator, is so critical to these facilities.

UPS systems can have a significant impact on an organization's sustainability goals – in some cases, an adverse impact on both sustainability and safety.

There is no such thing as a perfect battery. Every chemistry will have pros and cons and some amount of environmental impact. But battery chemistries differ widely in terms of availability and supply chain, ethics surrounding mining and labor, environmental impact, and safety.

So, while performance and safety are extremely important in a battery solution, let's also take a closer look at how your UPS battery may be hindering your sustainability efforts.


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Batteries and Their Supply Chains

Many rechargeable battery chemistries exist and are used in mission-critical applications:

- Aluminum
- Lead-acid
- Lithium-ion
- Nickel-cadmium
- Nickel-metal hydride
- Nickel-zinc
- Sodium-ion

There are also flow batteries: vanadium and iron-oxide. These battery chemistries are less common and tend to come at a higher initial price tag.

When we say "supply," we mean not just the availability of battery components but also the supply chain for those components. Every battery has core material sourcing, and some must travel a long way before reaching the manufacturer.

Aluminum is abundantly available, and aluminum batteries can use recycled material. This can help cut down on its energy-intensive refining and processing. The domestic supply chain, however, is poor; most aluminum comes from China and India. This means a higher footprint for transportation over long distances, though recycling can help.

Lead-acid batteries remain the most common battery chemistry in many mission-critical applications. China and Australia source raw lead, though the intensive lead-acid battery recycling program means recycled materials often are regionally or locally sourced.

Image courtesy of: https://sitn.hms.harvard.edu/flash/2019/how-electric-cars-can-become-truly-green-once-and-for-all/

Lithium-ion is fast becoming the most widely used battery chemistry. With the increase of electric vehicles (EVs), the worldwide supply of lithium is in growing demand, which is expected only to increase. The largest lithium-mining countries are Australia, Chile, China, and Argentina, and the cobalt needed for this battery chemistry comes from the Democratic Republic of Congo.

Nickel is relatively abundant but is heavily consumed by the steel industry. In addition, with much of the nickel supply located in Asian countries like Indonesia and the Philippines, the supply chain to the United States is long and carbon intense.

Sodium is available all over the earth, and as such, its supply chain is short and plentiful.

Ethics

Nearly every mineral used in modern technology must be mined. This means both land and labor use. In some cases, the ethics of extracting different battery materials cross ethical lines.

Aluminum mining poses few human rights issues, but the mining process is hard on the earth and produces a significant quantity of greenhouse gases (GHGs). Aluminum smelting produces nearly 300 metric tons of carbon dioxide a year.[1]

Lead is toxic, which is one reason a sophisticated recycling program has evolved around its use. This reduces the amount of lead that must be newly mined. But mining continues, and those workers—especially in developing countries—often are exposed to dangerous working conditions at low pay and with minimal government oversight.[2]

Mining has a devastating effect on the local ecosystem and produces substantial greenhouse gases. Image courtesy of Pexels (https://www.pexels.com/photo/mining-excavation-on-a-mountain-2892618/).

The high demand for lithium has resulted in the displacement of people and the destruction of various ecosystems. But the cobalt in lithium-ion batteries presents the worst ethical issue: cobalt miners, some of quite young ages, work in deplorable conditions in the Congo.[3]

Nickel mining has displaced many indigenous Indonesians and has serious ecological fallout for the islands.[4] A recent Wall Street Journal article calculated that a nickel mine in a forested part of the islands "caused greenhouse gas emissions equivalent to 56,000 tons of carbon dioxide. That's roughly equal to driving 12,000 conventional cars for a year, according to calculations by The Wall Street Journal based on U.S. Environmental Protection Agency data."[5] This is an enormous footprint to create the batteries intended for lower-footprint cars. And it can take the local environment many decades to recover from the strip-mining and deforestation process, even with the restoration efforts mining companies must perform.

Sodium-ion batteries require no rare earth or conflict minerals in their chemistry. The manganese oxide and iron oxide in these batteries are sourced from other industrial processes' waste, requiring no additional

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mining. Sodium-ion batteries also help companies meet decarbonization goals: Because they recharge so quickly – in a quarter of the time of lithium-ion and 1/32 of the time of lead-acid – they can better respond to back-to-back power outages, lower energy costs related to recharging, and reduce the amount of time generators must run.

Safety

How safe are the materials in these batteries? How prone are they to fires?

Aluminum-based batteries use a nonflammable electrolyte, making them much safer than traditional choices like lead-acid and lithium-ion batteries. They are, however, not technically rechargeable; they are refuellable.

Lead-acid batteries are bulky, heavy batteries stacked in the middle of sophisticated, modern facilities. These batteries can overheat when overcharged or discharged too rapidly, a necessary function of a UPS battery. Lead-acid batteries leak corrosive and extremely toxic sulfuric acid if damaged or cracked. For safe use, many hazard mitigations must be in place.

Lithium-ion batteries come with a high fire risk and are believed to have contributed to many catastrophic meltdowns in mission-critical facilities in the past five years, including one last year in South Korea and more than one in utility Battery Energy Storage Systems (BESS) in the U.S.[6] Lithium-ion batteries can be induced to thermal runaway when overcharged, physically damaged, exposed to high temperatures or humidity, or due to manufacturing defects. Lithium-ion battery fires and explosions can cause severe damage to mission-critical facilities and threaten people nearby. Because of these risks, there are tight regulations on the storage and transport of these batteries.

Nickel-based batteries are safe, as they are not capable of thermal runaway. These batteries vary in disposal safety, however. The zinc and metal hydride varieties are safer than cadmium, which is highly toxic both during the mining process and once the material is inside the batteries. All varieties of nickel-based batteries can lose capacity over time due to repeated charging after a partial discharge, known as the "memory effect."

Depending on the cell chemistry, some sodium-ion batteries such as those made by Natron Energy are inherently safe. They are significantly more power-dense than lithium-ion and lead-acid batteries, and they are 100% nonflammable and nonhazardous. This means they can be shipped fully charged, exposed to direct flame, and even punctured without any safety risk.

Image courtesy of CNBC (https://www.cnbc.com/video/2023/05/10/how-sodium-ion-technology-will-compete-with-lithium-ion-batteries.html)

Sodium-ion batteries can immediately discharge without risk of overheating, and they can operate in a wide temperature range (-32°F to 113°F) without safety risks. In UL 9450A testing, these batteries could not be induced to thermal runaway.[7] The technology's power capabilities also support peak shaving and other advanced energy management strategies.

Battery Reliability and ESG Goals Can Be Compatible

From common battery technologies like lithium-ion and lead-acid to those on the rise like sodium-ion, mission-critical facilities have many battery options. There is no simple, "one size fits all" battery choice. Every organization must assess their individual needs, applications, challenges, and risk tolerance.

For companies looking for a more sustainable, safe battery solution, traditional options don't stand up to newer, improved technologies. Looking beyond density to supply-chain availability, ethical impact, and safety can help mission-critical facilities achieve sustainability goals without compromising expectations for 100% uptime.

[1]*From IEA, aluminum smelting is "a significant source of CO2, emitting nearly 270 Mt of direct CO2 emissions in 2022 (about 3% of the world's direct industrial CO2 emissions)." https://www.iea.org/energy-system/industry/aluminium*
[2]*See this article from Main Group Metal Chemistry, https://www.degruyter.com/document/doi/10.1515/mgmc-2020-0019/html?lang=en*
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[4]*See Earth Island Journal, https://www.earthisland.org/journal/index.php/articles/entry/nickel-mining-puts-indonesian-fishers-on-edge/*
[5]*"EV Makers Confront the 'Nickel Pickle'," June 4, 2023, https://www.wsj.com/articles/electric-vehicles-batteries-nickel-pickle-indonesia-9152b1f*
[6]*South Korean fire: https://www.datacenterknowledge.com/business/data-center-fire-triggers-lithium-ion-battery-doubts-south-korea and BESS fires: https://www.silive.com/news/2023/07/as-2-lithium-ion-battery-site-fires-smolder-in-warwick-more-questions-raised-over-staten-island-facilities.html*
[7]*Download Natron Energy's sodium-ion battery testing report here: https://natron.energy/battery-safety/*

Brian Kennedy is Director of Business Development and Marketing at Natron Energy. He can be reached at brian@natron.energy.

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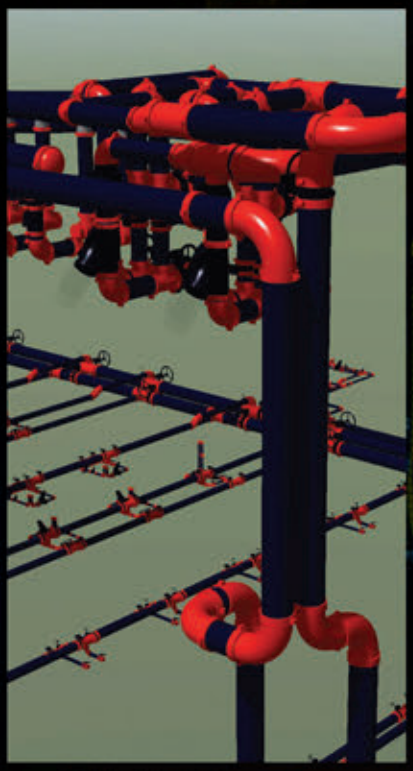

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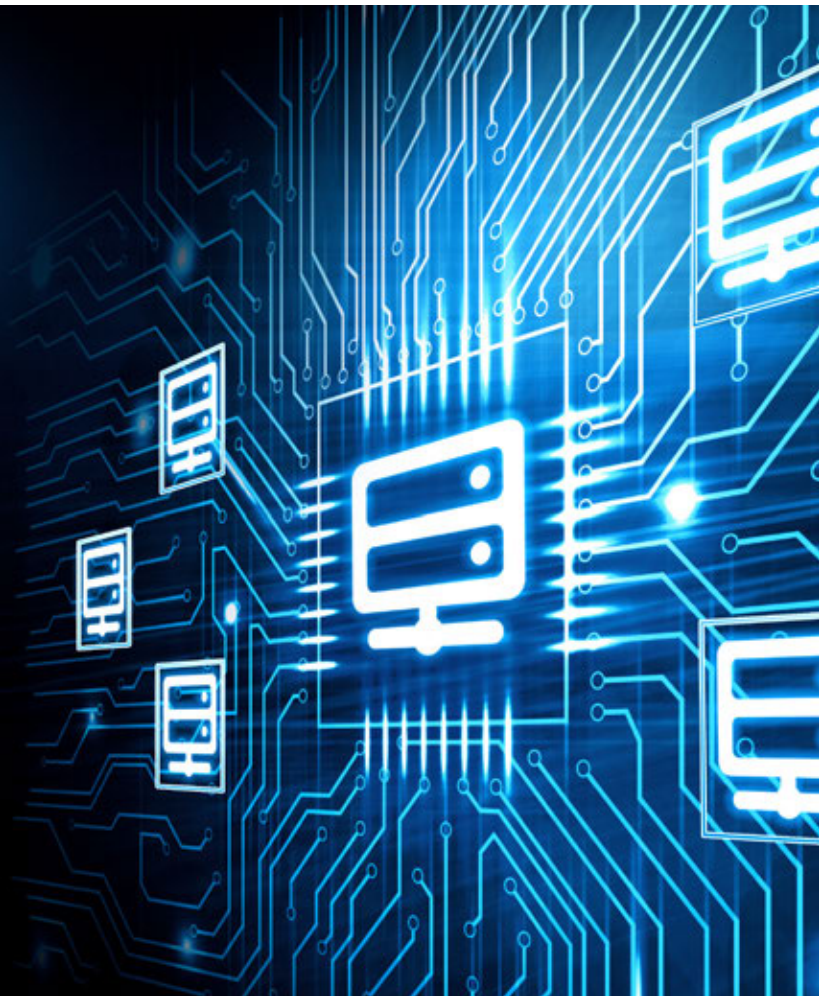
Introducing IT Room Utilization (ITRU). A method to assess and look for potential improvement of the IT Load utilization.

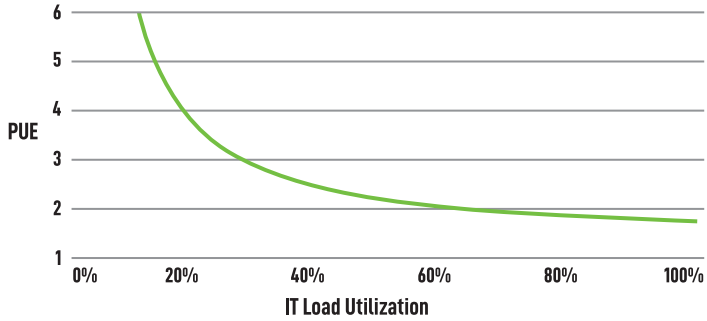


by Jorge A. Gil, DCEP

1. THE DESIGN PUE CURVE IS ALL ABOUT THE SITE INFRASTRUCTURE LEVEL OF EFFICIENCY AND IT UTILIZATION.

Every Data Center facility has a Design PUE curve, sometimes implicit, so the owners and operators might not be aware of that. This curve is basically the result of the Data Center's designed level of energy efficiency as the function of the IT Load utilization. So, the Design PUE value is obtained at 100% of IT Load Utilization. In figure 1, there is an example of a Design PUE curve.

Figure 1. Typical PUE Design Curve



Understanding the correlation between the PUE value and IT Load utilization is an important take, since once the Data Center is in the operational stage, there might be very few things to do in order to improve its efficiency, without retrofitting the site. So, trying to improve the IT Load utilization might sound like the logical first step before getting into the Site Infrastructure side. By optimizing the IT Load first, we can look for a better adjustment of the Site Infrastructure optimization later, getting the best possible efficiency scenario.

The IT Room Utilization (ITRU) set of metrics, can effectively be used in assessing the current state of the IT Load utilization and Room occupancy, of any Data Center implemented with Racks (EIA-310-D and/or OCP Racks).

The IT Room Utilization (ITRU) method, is a way to assess the maximum Potential utilization of the IT Load, by modeling and projecting the consolidation of IT Equipment into fewer Racks, and deactivating the empty Racks and its collateral Site Infrastructure.

The interesting side about the ITRU method is that it helps in projecting improvement scenarios with few input data collected from the Data and Telco Room, producing key information about the current state of the overall Room efficiency and the future potential optimization.

2. HOW CONTROLLING THE IT SPACE CAN IMPROVE THE IT LOAD UTILIZATION

The IT Room Utilization (ITRU) proposes a way to measure the IT Load utilization in a standardized way, as in the equation:

ITRU = Average Used IT Load / Design IT Load

Where the *Design IT Load*, is obtained by the Summation of Total Rack Capacity (typically in kW) in the Computer/Telco Room. The *Average Used IT Load* will be the average power consumption by IT Equipment in the Computer/Telco Room.

As IT Equipment are usually arranged in Racks, having a standard way to measure the total Room occupancy with respect to its functional approach (Rack Units), is key in order to be able to improve its efficiency.

Rack Usage Ratio (RUR) is a way to measure the occupancy of the Computer/Telco Room capacity, in terms of the IT Equipment functional space (Rack Units or Open Units). As Site Infrastructure components capacity are directly dependent of the IT Racks power capacity (aka Rack Power Density), the reduction of IT Racks might directly impact Site Infrastructure components. However, the amount of Site Infrastructure equipment to be impacted will depend on the way the Computer Room is designed. Highly modularized Computer Room architectures will be more impacted than less modularized ones. Understanding the relation between the Site Infrastructure Components and the IT Racks, is an important take in order to understand how efficient a Data Center might operate.

In addition to Rack Occupancy (RUR), it's also important to know what the average Rack Power Density usage is, also according to its functional space (Rack Units or Open Units), and the resulting indicator called Rack Power Ratio (RPR), was designed to address that need.

Rack Power Ratio (RPR), is an important metric, since it allows you to determine:

- A sense of the level of Computer Room potential efficiency range, after consolidating IT Racks at 100%.
- The maximum Potential Utilization at 100% of Rack Occupancy.
  Potential ITRU = RPR x 100%
- RPR>100% means Power overload at Rack Unit Level.
- RPR<=100% means No Power overload at Rack Unit Level, therefore potential to move IT Equipment to other Racks with the same Rack Power Density.

Finally, as RPR and RUR are related to Rack Units, ITRU alternative equation can be used to project potential IT Load utilization scenarios (ITRU alternative method).

ITRU = RPR * RUR

Summary of ITRU Set of Metrics.

- **IT Room Utilization (ITRU):** measures the IT Load utilization ratio, as in the Equations:

$$\mathbf{ITRU} = \frac{\text{AVG\_USED\_IT\_LOAD}}{\text{DESIGN\_IT\_LOAD}} \ \mathbf{\%}$$

- **Rack Usage Ratio (RUR):** measures the Room Occupation ratio, considering Open Units (OCP) or Rack Units (EIA-310-D), as in the Equation:

$$\mathbf{RUR} = \frac{\text{U\_USED}}{\text{U\_TOTAL}} \ \mathbf{\%}$$

Where:

U_USED is the total of units (Rack Units or Open Units) occupied with IT equipment. U_TOTAL is the total of units (Rack Units or Open Units) available for IT Equipment (occupied units + empty units).

- **Rack Power Ratio (RPR):** measures the average use ratio of Rack Power Density relative to Open Units (OCP) or Rack Units (EIA-310-D) level, as in the Equations:

$$\mathbf{RPR} = \frac{\text{AVG\_USED\_IT\_LOAD / U\_USED}}{\text{DESIGN\_IT\_LOAD / U\_TOTAL}} \ \mathbf{\%}$$

RPR metric and Potential ITRU (Potential IT Load Utilization).

The RPR (Rack Power Ratio), helps in projecting the Potential ITRU improvement, after consolidating the Rack Space.

The RPR will be the maximum theoretical ITRU value (utilization) to be obtained, by consolidating the IT Equipment at 100% of Rack occupancy: *Potential ITRU max = RPR x 100%.*

However, the real Potential ITRU, for any assessed Data Room can be obtained by the following equation:

POTENTIAL ITRU = RPR * POTENTIAL RUR

The Potential RUR (Rack Usage Ratio), will be obtained after dividing the Total used Rack Units (used by IT Equipment) by the resulted value of multiplying the Racks Needed by Racks Units per Rack (If RPR<=100%).

Projecting the Racks Needed is critical, since it's the basis for Rack Consolidation. After calculating the *Racks Needed,* the remaining Racks can be effectively deactivated, potentially impacting the correlated Site Infrastructure.

The RPR indicator can also be used to determine if there is overload at Rack Unit level (RPR>100%). In that case, it helps during the Rack consolidation process by preventing the overload at Rack level (avoiding a safety issue).

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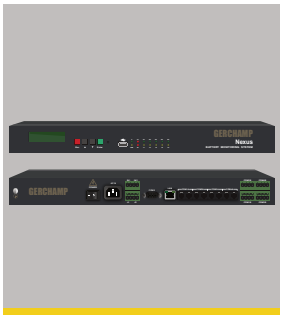

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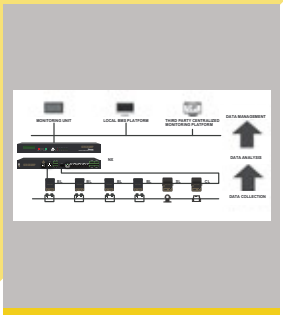


Topology

Topology Image

The Gerchamp battery monitoring system (BMS) is a high-end product specially designed for the mission critical backup power systems. The BMS can provide early warning of a thermal runaway event of battery systems and battery equalization. Products meet the requirements of the ANSI/TIA-942 standard.

Modeled Computer Room

Figure 2 shows a modeled Computer Room, with Site Infrastructure components (UPS/CRAH), with two PODs (Point of Delivery) with identical distribution. IT Racks shown both have different levels of occupancy and average power consumption.

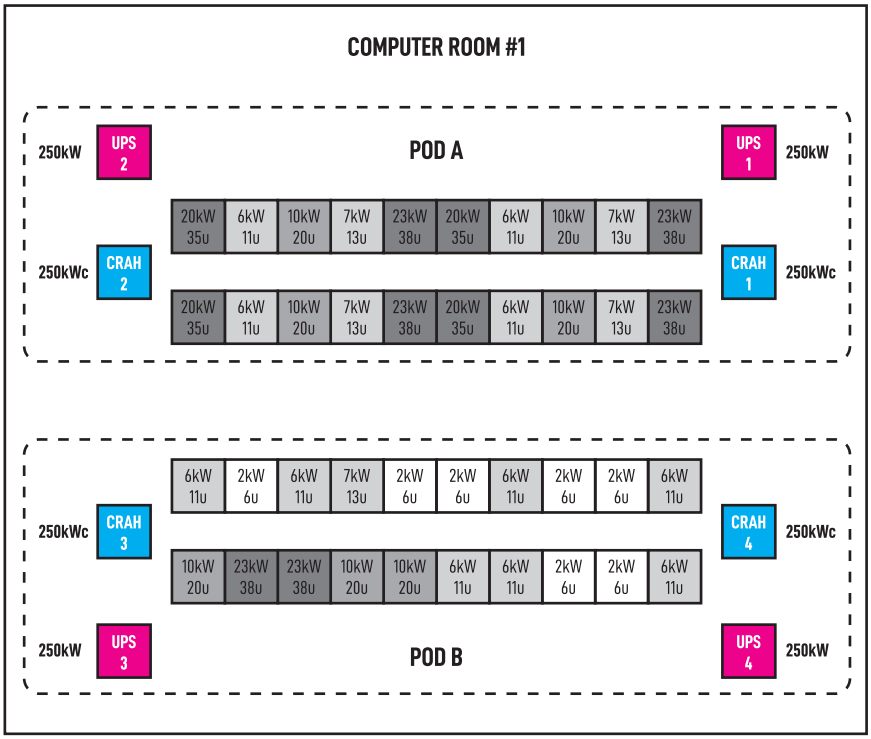
Modeled Computer Room #1 data:

- Total ROOM RACKs: 40 RACKs
- Total RACKs per POD: 20 RACKs
- RACK Capacity (kW /RACK): 25kW
- Rack Units per RACK (active): 40u
- Total Units per POD (20 RACKs x 40u): 800u
- Total POD A used Units: 468u
- Total POD B used Units: 268u
- ROOM Design IT Load (2 PODx500kW): 1000kW
- POD A - Avg used IT Load: 264kW
- POD B – Avg used IT Load: 139kW

Site Infrastructure Components:

- Total UPS Components: 4 x 250kW
- Total CRAH Components: 4 x 250kWc

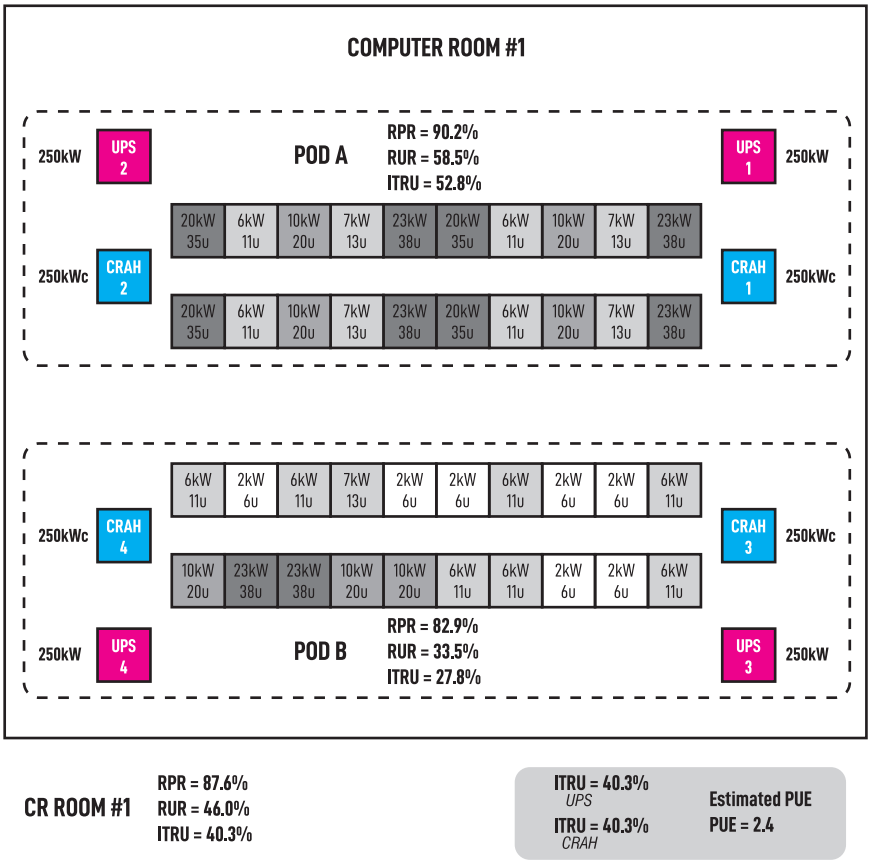
Figure 2. Modeled Computer Room #1 layout



The original ROOM level ITRU=40.3% (Low Utilization) and RUR=46.8% (Low Occupancy), initially shows a poor performance scenario. The PUE=2.4 can be easily explained since the utilization (ITRU) is at 40.3% for Site Infrastructure components (UPS/CRAH) (Potential ITRU*si_comp*=40.3%).

The estimated ROOM level RPR=87.6%, gives an initial indication of potential IT Load utilization improvement, if IT Equipment are theoretically rearrange at 100% occupancy. The current state of the Computer Room #1 ITRU metrics, are shown in Figure 3.

Figure 3. Modeled Computer Room #1 with ITRU Metrics and PUE



After executing the ITRU assessment method, the ROOM Potential ITRU=84.8% could be obtained, by consolidating the IT Racks at Potential RUR=96.8% (Occupancy ratio). By deactivating the IT Racks left empty, the consolidated IT Racks has a "new Design IT Load"=475kW (19 Racks x 25kW/Rack). The resulted values of the ITRU metrics at ROOM Level are the same for any scenario, however the impact to Site Infrastructure components will vary depending of the optimization approach to be implemented. As the Computer Room #1 is arranged with 2 PODs, there would be two potential scenarios:

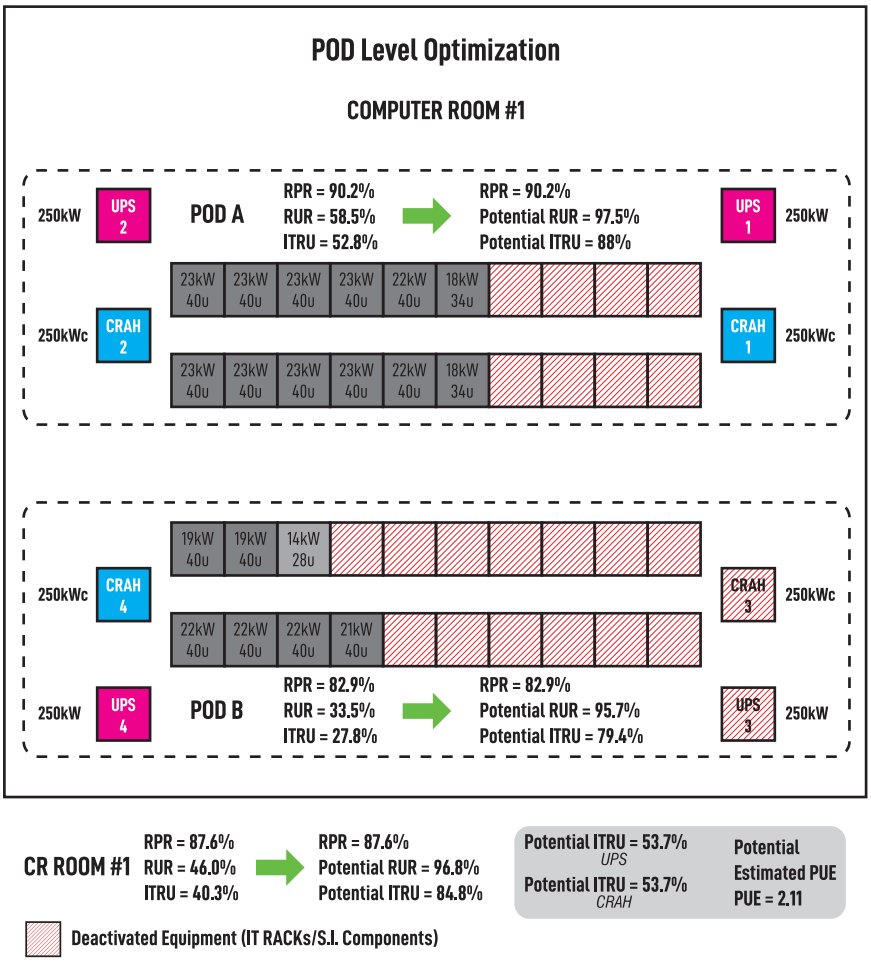
- POD Level Optimization scenario
- ROOM Level Optimization scenario

POD Level Optimization

This scenario was considered in case of having different owners for each POD. In that case, the analysis for potential improvement has to be done independently. Figure 4 shows the modeled POD Level Optimization with metrics.

The current state of the POD A shows a better IT Load utilization, compared with the POD B (POD A ITRU=52.8% vs POD B ITRU=27.8%). The Potential utilization of the POD A is also better compared with the POD B (POD A Potential ITRU=88% Vs POD B Potential ITRU=79%). However, since every POD was designed with 2 Site Infrastructure components for both UPS and Cooling equipment (10 Racks per SI Component), POD A has to operate at its full capacity (SI Components) after potentially consolidating the IT Racks. On the other hand, Site Infrastructure components for POD B, could be potentially deactivated to its half, after consolidating the IT Racks. The overall gain would be an improvement to Potential ITRUsi_comp=53.7%, with an estimated PUE=2.11.

Figure 4. Modeled POD Level Optimization with Metrics.



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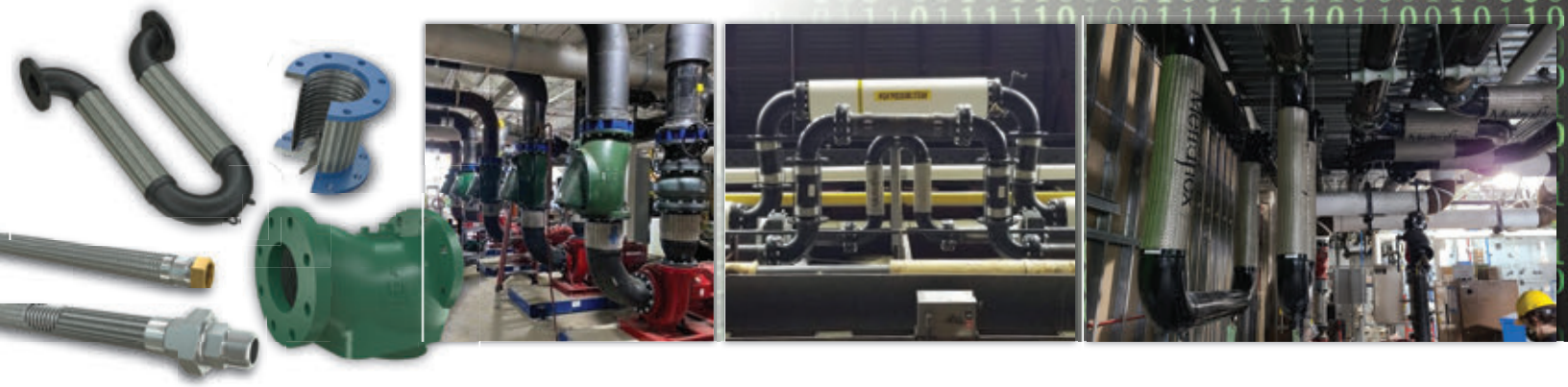

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ROOM Level Optimization

The Room Level Optimization scenario, shown in figure 5, would be the best possible scenario, since it allows for deactivating greater amount of Site Infrastructure components correlated to the Racks left empty, after the potential consolidation process.

The overall improvement of Potential ITRU*si_comp*=80.6%, approaching to the Potential ITRU=84.8% of the Room, can be achieved thanks to the complete deactivation of one of the PODs, reducing the PUE to 1.84 (Estimated Value).

Figure 5. Modeled ROOM Level Optimization with Metrics.

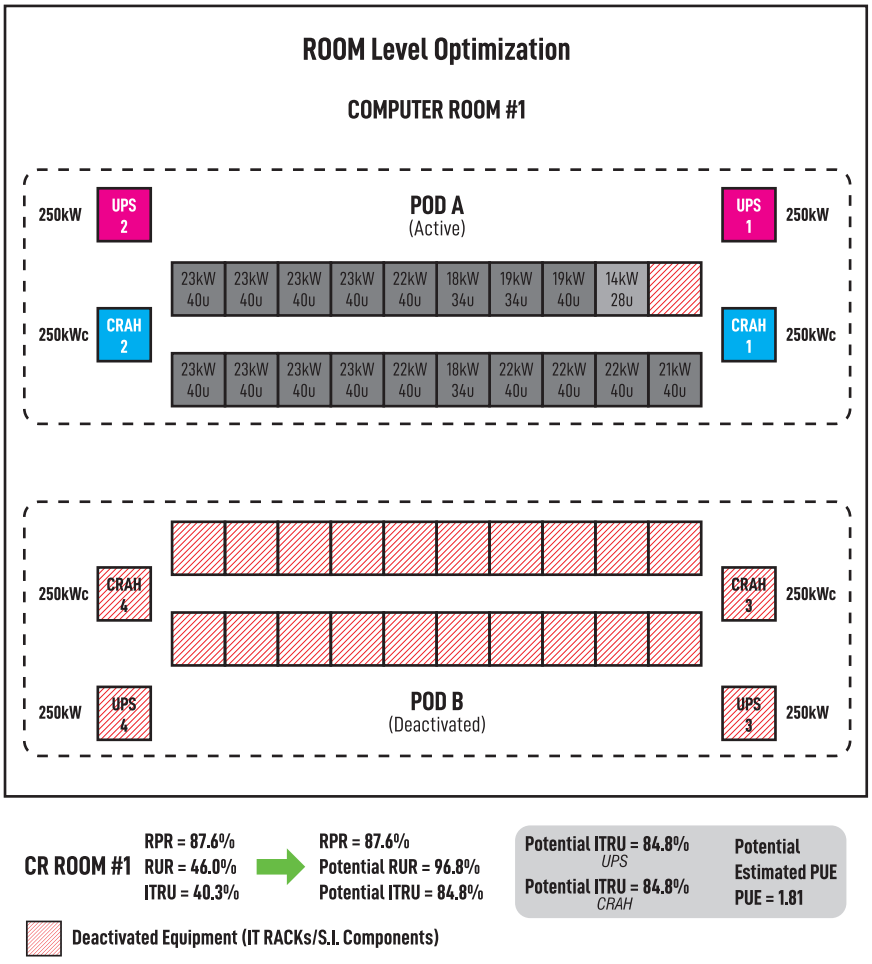


Figure 6 shows the comparison of each scenario using the ITRU Metrics and PUE, demonstrating the effectiveness of the ITRU metrics to assess the current state with potential improvement scenarios. As the ITRU (IT Room Utilization) is a relation of Total Rack Capacity usage, it is important to compare the IT Load utilization of each Site Infrastructure Component (Potential ITRU*si_comp*), in order to project the impact to PUE.

The following equation for Potential ITRU*si_comp* could be used in order to estimate the total utilization of any type of Site Infrastructure component, with respect to the IT Load:

$$\mathbf{RPR} = \frac{\text{AVG\_USED\_IT\_LOAD} / \text{U\_USED}}{\text{DESIGN\_IT\_LOAD} / \text{U\_TOTAL}} \ \%$$

Figure 6. Comparison of Potential Improvement scenarios

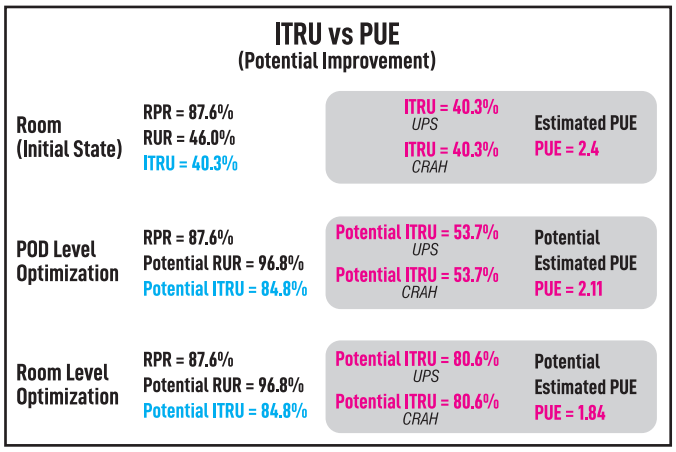
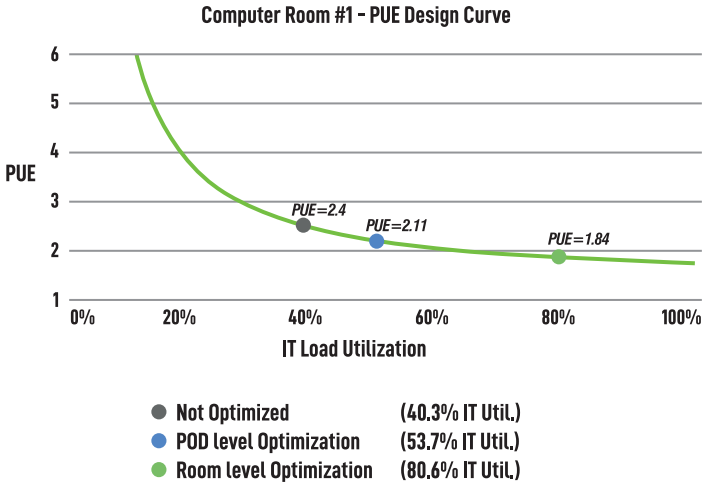


Figure 7. PUE Design Curve with PUE values of modeled scenarios



3. CONCLUSIONS

The ITRU method and set of metrics are designed to measure the Rack occupancy of the Computer/Telco Room, in order to assess both the potential improvement of the IT Load utilization and the potential improvement of the energy efficiency at facility level.

As estimating the PUE usually requires CFD software or similar tools, the ITRU metrics can be used independently to demonstrate the potential improvement of the Computer Room, and its impact to Site Infrastructure components in a simple manner.

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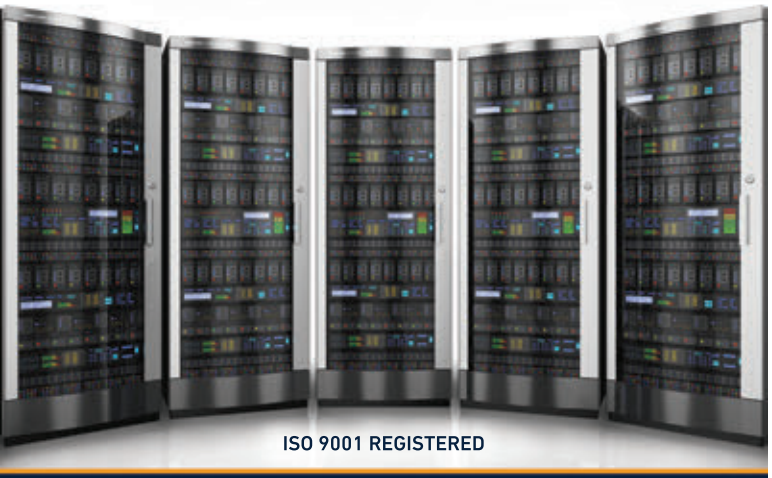

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SUSTAINABILITY OPPORTUNITIES

October 8-11, 2023
Gaylord Texan Resort, Grapevine TX

END-TO-END RELIABILITY:
MISSION CRITICAL FACILITIES

2023 FALL CONFERENCE HIGHLIGHTS

The Fall Conference themed "End-to-End Reliability – Sustainability Opportunities" will be held October 8-11, at the Gaylord Texan in Grapevine, TX. The Conference will feature compelling keynotes, high level speakers, concurrent sessions, a Women in Mission Critical Operations networking event, the Marquis Plus+ Partner Showcase, a Rock n' Roll BBQ and more…

Celine Cousteau, Explorer and Filmmaker, will kick off the conference with a keynote address on the topic ***"Inspired and Connected – People and the Natural World"***

Socio-environmental speaker Céline Cousteau travels the world, documenting the interconnection of nature and humans. From the jungles of the Amazon to remote islands near the Arctic, people have always maintained strong connections with the natural world around them. Through film, photo, and voice Céline reveals how our cultures and the plants and animals that surround us are all interconnected, illustrating the undeniable connection between the health of the environment and the survival of us all.

Our second conference day will open with a Keynote ***"Can you Handle the Heat? Data Center Cooling Considerations in Machine Learning, Deep Learning and AI Applications"*** by ***Phill Lawson-Shanks,*** Chief Innovation and Technology Officer, Aligned Data Centers.

The closing keynote ***"Jumpstarting the Journey to Decarbonization"*** will be delivered by ***Stacey Mahler,*** Dead of Sustainability, SIEMENS Smart Infrastructure, SIEMENS and ***Sean Metivier,*** Head of Energy Efficiency and Sustainability Consulting, SIEMENS.

Additional presentations will be delivered on compelling mission critical industry topics:

- Harnessing the Power of AI
- Adobe Data Center Case Study
- Digital Infrastructure Sustainability – Some Inconvenient Truths
- Finally, Cost Effective Options to Replacing Diesel Backup Power in Data Centers
- Don't Fear Liquid Cooling – Plan for IT
- The Elephant in the Room – An Industry/University Perspective on the Current and Future Challenges in the Data Center and Sustainability
- Increasing Sustainability through Modular Data Center Design
- Is Nuclear the Key to Sustainability Energy for Data Center s and Beyond

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Wally Palmar


Johnny Edwards


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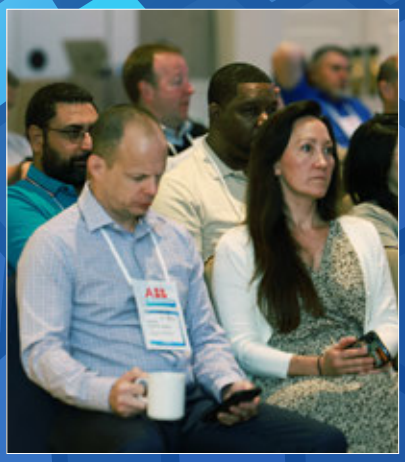

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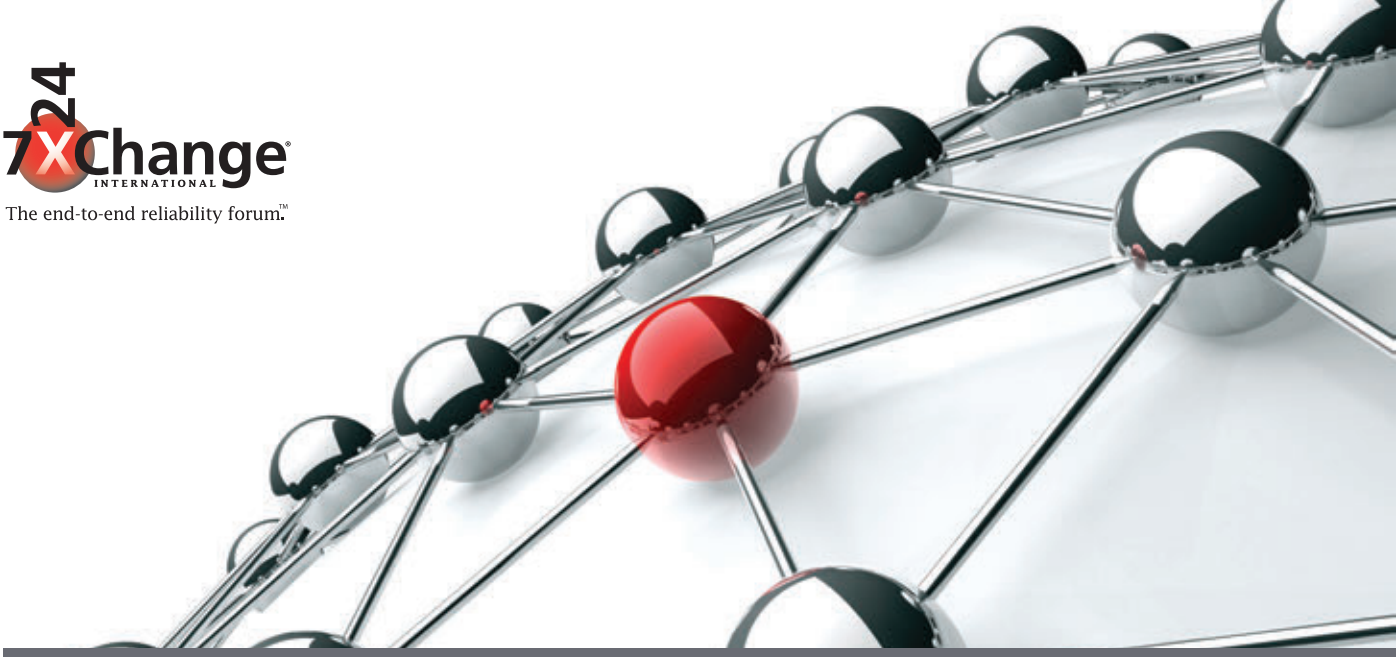

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As the leading knowledge exchange in the mission critical space, 7x24 Exchange recognizes the importance of increasing the engagement and participation of women in the industry. This understanding has led to the development of 7x24 Exchange WiMCO (Women in Mission Critical Operations) which will focus on:

- **Recruiting women into the 7x24 Exchange organization**
- **Supporting WiMCO initiatives at the Chapter level**
- **Promoting mission critical opportunities for women**
- **Providing leadership opportunities through the community**

2023 Spring Conference WiMCO Session Speakers
Left to right: Kerry King, Director, Global Data Center Facility Operations Support, Meta;
Robin Daly, Vice President, Envirotrol; Lillian Rivera, Director of Marketing, Bureau Veritas Primary Integration;
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INTERNATIONAL DATA CENTER DAY
Powered by 7x24 Exchange International

2023 INTERNATIONAL DATA CENTER DAY RECAP

by Denman Wall, Sr. Director, Interactive Services, 7x24 Exchange International

March 22, 2023, marked the celebration of the 5th International Data Center Day. Launched in the fall of 2019, International Data Center Day is designed to create awareness of the data center industry and to inspire the next generation of talent. It provides the industry with an opportunity to open its doors and show, in a collaborative effort, what data centers are, why they are so important to our connected world, and the wide array of career opportunities that are part of the data center industry.

Although this year's celebration was held March 22, the organization encourages those in the mission critical industry to engage in raising awareness of the industry year-round. To that end, the new motto is "Every Day is International Data Center Day."

THIS YEAR'S THEME IS DATA CENTER CONNECT

This year's main activity is called Data Center Connect, which encourages professionals to connect with schools in their local area. If each data center professional connects with a local school, think of how many students will consider a career in the critical field.

Listen to The Thought Cloud Here

THE THOUGHT CLOUD PODCAST

THE KICKOFF

This year's International Data Center Day season kicked off with The Thought Cloud Podcast interview of Bob Cassiliano, chairman & CEO of 7x24 Exchange, and Brian Schafer, president of the Metro New York Chapter of 7x24 Exchange.

Together they educated listeners on the origin of the initiative, the various ways to participate in raising awareness of the data center industry, and how to inspire the next generation of talent.

Bob Cassiliano

Brian Schafer

ONLINE PRESENTATION

Next up was a webinar hosted by 7x24 Exchange entitled "Bridging the Data Talent Divide with On-ramps" presented by Carrie Goetz, Principal/CEO, StrategITcom and author of Jumpstart your Career in Data Centers. The 30-minute presentation introduced the many facets of data center careers to college students.

7X24 EXCHANGE CHAPTERS PARTICIPATED BY HOSTING ACTIVITIES WITH SPONSORS IN THEIR LOCAL AREAS.

The **Greater Washington D.C. Chapter** held a 4.99999 Cloud Run in their local area. Despite the inclement weather, many people participated in the event showcasing local-area data centers. Proceeds of this race benefitted Dulles South Soup Kitchen and the 7×24 Exchange DC Chapter Scholarship Fund.

The **Northwest Chapter WiMCO** community hosted 16 students from Bothell High School and Woodinville High School to learn more about careers in the data center industry. They also received a rare opportunity to tour the AT&T Bothell 9 Data Center. The kids were engaged and asked so many great questions. It is our hope that we can repeat this event for years to come.

Netrality Data Centers celebrated International Data Center Day, powered by 7×24 Exchange International, at their 401 N Broad facility in Philadelphia on March 22nd. Students from Liguori Academy, Delsea Regional, and Roman Catholic High School were hosted by the company.

After the presentation, students took a tour of Netrality's facilities and visited their tenant Nerd Street, a national network of esports facilities and events dedicated to powering competitive opportunities for gamers.

Cloud Run participants at the finish line.

Students at the Bothell 9 facility.

Students learning about data center operations.

Students visited Netrality tenant Nerd Street, a national network of esports facilities

7X24 EXCHANGE INTERNATIONAL CONTINUES TO BUILD ITS INTERACTIVE CAREER TREE.

Visitors who use the career tree can learn from industry professionals about different career paths within the mission critical industry. With many branches containing well over 20 leaves, users can watch video interviews from sales and marketing, operations, design, and information technology professionals.

We encourage data center professionals to help us grow and nurture the Interactive Career Tree by volunteering for interviews to be featured there.

View the Interactive Career Tree

INTERNATIONAL DATA CENTER DAY IS THRIVING, AS EVIDENCED BY THE AMOUNT OF SUPPORT SEEN ON SOCIAL MEDIA AND SHARED WITH 7X24 EXCHANGE.

It is terrific to see organizations and individuals not only adopting the initiative but enthusiastically raising the bar of their celebrations year after year.

ORGANIZATIONS FROM ALL OVER THE GLOBE SHOWED THEIR SUPPORT FOR INTERNATIONAL DATA CENTER DAY.

Data Centers, mission critical teams, and other tech firms gave in-person tours to students, created interactive content and rich social media highlighting their activities. At one point, on March 22, the organization was even mentioned by one commentor as causing a "Tweetstorm," which is considered a sort of badge of honor on the platform.

Want to show your support throughout the year? Be sure to post your events on social media and tag us with #intldatacenterday

To see other examples of the impact of the day's reach,
visit https://www.internationaldatacenterday.org/activities/

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