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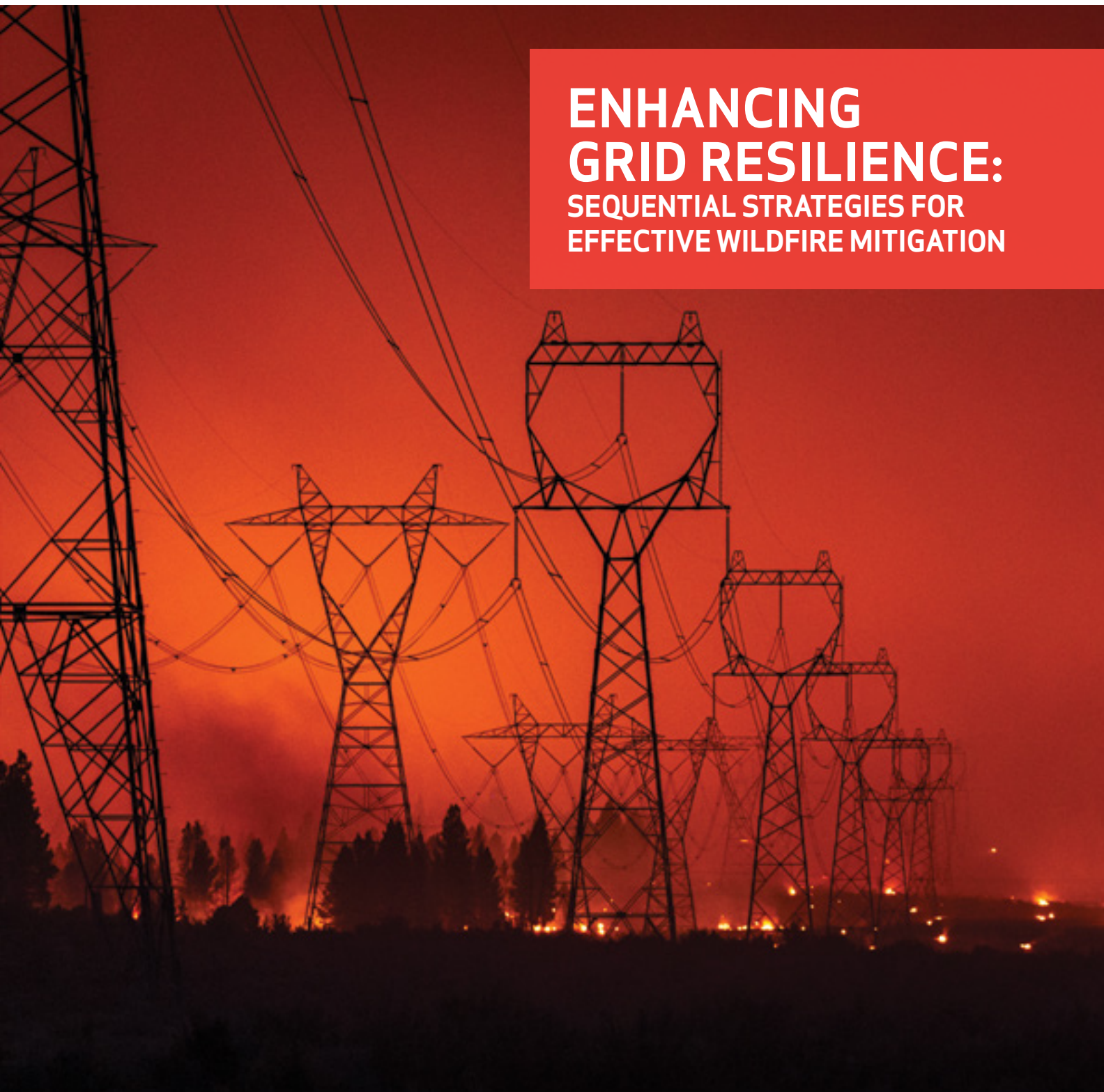

ENHANCING GRID RESILIENCE:
SEQUENTIAL STRATEGIES FOR EFFECTIVE WILDFIRE MITIGATION

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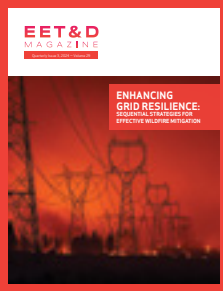

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U.S. DEPARTMENT
OF ENERGY

BIDEN- HARRIS ADMINISTRATION ANNOUNCES NEARLY $85 MILLION TO ACCELERATE DOMESTIC HEAT PUMP MANUFACTURING

Funding from the Investing in America Agenda Invoked by The President's Use of the Defense Production Act Would Boost U.S. Manufacturing, Create Clean Energy Jobs, and Lower Energy Bills for Households Across the Nation, While Protecting National Security

August, 2024

As part of the Biden-Harris Administration's Investing in America agenda, the U.S. Department of Energy (DOE) today (Aug 7) announced nearly $85 million across four heat pump manufacturers to accelerate the manufacturing of electric heat pumps, heat pump hot water heaters, and heat pump components at five factories in New York, Tennessee, Texas, and Rhode Island. The selected projects are the second round of awards from DOE's authorization, invoked by President Biden using emergency authority on the basis of climate change, to utilize the Defense Production Act (DPA) to increase domestic production of five key clean energy technologies, including electric heat pumps. The projects, administered by DOE's Office of Manufacturing and Energy Supply Chains (MESC), would collectively create over 500 high-quality, good-paying jobs, including 220 jobs in disadvantaged communities, supporting President Biden's goals of spurring economic growth and maximizing the benefits of clean energy to all communities. In alignment with President Biden's Justice 40 Initiative and funded by the Inflation Reduction Act the largest climate investment in U.S. history selected projects will further the Administration's buildup of a clean energy economy, create high quality manufacturing jobs, help families and businesses save money on their energy bills, and bolster national security by reducing energy reliance on fossil fuels and foreign adversaries.

> ***"Extreme weather events are harming our grid and serving as a primary driver of higher electricity bills, underscoring the need to increase access to energy efficient technologies," said U.S. Secretary of Energy Jennifer M. Granholm. "The Biden-Harris Administration's Investing in America agenda is manufacturing hundreds of thousands of energy-saving heat pumps here in the USA, helping American households and businesses keep money in their pockets all while strengthening our national security and creating good-paying jobs."***

"Under President Biden and Vice President Harris's leadership, the United States is supercharging U.S. clean energy manufacturing, which is creating good-paying jobs, lowering families' energy costs, and helping tackle the climate crisis, all while boosting our nation's energy security," said **White House National Climate Advisor Ali Zaidi**. "As communities across the country continue to face down the impacts of climate-fueled extreme weather events, investing in American-made heat pump manufacturing will help keep families safe and comfortable in their homes, schools, and businesses and cut their energy costs. Today's investments, levering the authorities in the Defense Production Act, harness the power of American innovation to jumpstart critical clean energy manufacturing capacity and to protect our families, our economy, and our planet." →

The DPA investments being announced today would increase American manufacturing of heat pump technologies, which provide efficient space heating and cooling and water heating for homes, schools, and commercial and industrial uses. The awards will also increase the number of compressors produced on U.S. soil, which are typically manufactured overseas in Europe and Asia, making it easier for domestic manufacturers to use these key components in American-made heat pumps. Together these investments will allow for U.S. manufacturing of an additional 155,000 residential heat pumps, 440,000 residential heat pump water heaters, 2,000 school heat pumps, and 20,000 large heat pump compressors each year.

Today's DPA manufacturing investments complement the direct consumer savings that the Biden-Harris Administration is providing, with the Investing in America agenda making homeowners now eligible for up to a 30% federal tax credit on the total cost of buying and installing a heat pump, and providing states with funding for home energy rebate programs.

Heating and cooling buildings, homes, offices, schools, hospitals, military bases, and other critical facilities drive more than 35% of all U.S. energy consumption and contribute more than one third of greenhouse gas emissions. Heat pumps can efficiently provide heating and cooling and hot water for homes and businesses, especially when homes are well insulated. Electric heat pumps reduce greenhouse gas emissions by up to 50% compared to the most efficient condensing gas boilers today, and this percentage could grow to 75% by 2030. Heat pump water heaters can be two-to-three times more energy efficient than conventional electric water heaters, and on average, heat pumps can save homeowners between $300 to $1,500 annually depending on the current sources for heating and cooling. Additional savings are currently available through the Inflation Reduction Act Energy Efficient Tax Credit 25C tax credits to help consumers afford heat pumps. To learn more about savings and how heat pumps work, visit Pump Up Your Savings with Heat Pumps.

U.S. DEPARTMENT OF ENERGY AWARDS DUKE ENERGY PROJECT $57 MILLION IN COST-SHARE FUNDING TO ENHANCE NORTH CAROLINA'S ENERGY GRID

Grant will help fund 40-mile transmission line rebuild in Wake, Johnston and Wayne counties to improve reliability for an estimated 14,000 customers

August, 2024

U.S. Secretary of Energy Jennifer Granholm today (Aug 6) announced the U.S. Department of Energy (DOE)'s Grid Deployment Office has selected the North Carolina Innovative Transmission Rebuild project to receive $57 million in cost-share funding to enhance the power grid's ability to deliver affordable, resilient energy. The project - a partnership between Duke Energy, the North Carolina Department of Environmental Quality and State Energy Office - aims to reconstruct the 230-kV Lee-Milburnie transmission line to improve reliability for customers and meet growing electricity demand in eastern North Carolina.

> *"The grant announced today by the Department of Energy is a win for the communities Duke Energy serves, and signals North Carolina's leadership in the energy transition," said Kendal Bowman, Duke Energy North Carolina state president. "This project will help reduce outages, enhance the power system's resilience against extreme weather, enable the connection of more clean energy sources to the grid and create job opportunities and new partnerships with community organizations."*

The Lee-Milburnie transmission line spans from the Greater Raleigh area to outside Goldsboro, N.C., including portions of Wake, Johnston and Wayne counties. The line rebuild will take place in the existing right of way to minimize the impact to nearby communities.

> *"Supporting our customers by helping ensure they have reliable service and restoring that service safely and quickly when we need to is our No. 1 job," said Scott Batson, senior vice president and chief power grid officer at Duke Energy. "The generous grant provided by the U.S. Department of Energy for this transmission line reconstruction work will improve the reliability of the grid while delivering affordable, clean energy to our customers."*

The funds are part of the Grid Resilience and Innovation Partnerships (GRIP) program, the federal government's single largest direct investment into critical grid infrastructure. Funded through the Bipartisan Infrastructure Law and administered by DOE's Grid Deployment Office, the GRIP program leverages federal and private investments to support a reliable grid that is prepared for extreme weather while also delivering affordable, clean energy and creating local economic opportunities. →

"This funding will help support North Carolinians' efforts to invest in grid resiliency, improve reliability, and meet electricity demand," said U.S. Secretary of Energy Jennifer M. Granholm. "The Biden-Harris Administration is investing in the most crucial component of the nation's infrastructure, expanding and hardening the grid to allow more resilient, clean power to reach more household, and support the ongoing manufacturing boom all while creating thousands of local jobs."

This North Carolina Innovative Transmission Rebuild will create robust opportunities for local economic development, including significant investments in workforce development programs at Nash Community College and North Carolina A&T State University.

"North Carolina A&T State University and STEPs4GROWTH are proud to be partners in developing a skilled workforce in support of Duke Energy's efforts to deliver reliable, affordable energy to its customers," said Balu Gokaraju, Ph.D., principal investigator for the STEPs4GROWTH program. "This project represents a significant investment that will not only enhance the grid but also benefit the community by creating good jobs with family sustaining wages."

The joint effort will create an estimated 550 new jobs that can be filled through partnerships with historically black colleges and universities (HBCUs) and local community colleges.

"We have been a proud partner of Duke Energy for many years and are truly excited about this new initiative to enhance power grid reliability in North Carolina," said Lew K. Hunnicutt, President of Nash Community College. "We look forward to doing our part to support this important project, which will benefit our community through new job opportunities for skilled workers."

To learn more, visit the U.S. Department of Energy Grid Deployment Office's website.

AN ESTIMATED

550

NEW JOBS

Scottish & Southern Electricity Networks

SSEN TRANSMISSION WELCOMES OFGEM'S CONSULTATION ON 'BEYOND 2030' GRID ENHANCEMENTS

SSEN Transmission has welcomed Ofgem's consultation on its proposed 'Beyond 2030' projects, which is the next step in unlocking the next phase of grid infrastructure investment.

August, 2024

The launch of Ofgem's consultation today (Aug 1) confirms its agreement, as the industry regulator, on the need for the National Grid ESO's proposed 'Beyond 2030' plan for major transmission network investments across the north of Scotland, which are essential in order to help reach net zero. The consultation also sets out the regulatory delivery pathways required to progress these projects.

Following on from the ESO's Pathway to 2030' Holistic Network Design from 2022, National Grid ESO's Beyond 2030' plan was announced in March this year and outlines the next tranche of projects required to connect all of the ScotWind offshore wind projects. The plan will also enable the connection of other low-carbon technologies, further supporting the country's transition to net zero and helping deliver energy security through the deployment of homegrown, low-carbon electricity generation.

In the north of Scotland, Ofgem supports the ESO's plan, confirming the need for a number of projects to proceed for delivery by the mid-2030s. Combined, this represents a potential estimated investment of over £5bn for SSEN Transmission and includes:

ESO code	Description
Shetland Hub	**A second High Voltage Direct Current (HVDC) subsea link from Shetland, connecting to Coachford (Blackhillock 2) substation**
DSUP	**A new 400kV double circuit between Dounreay, Thurso ans Banniskirk (Spittal 2), with new 400kV substations at Dounreay and Thurso**
BKUP	**Rebuild the existing Blackhillock-Kintore 275kV double circuit to 400kV with a new 400kV substation required along its route**
PKUP	**Increase the capacity of the planned Peterhead to Longside (Peterhead 2) 400kV double circuit with a higher capacity 400kV double circuit; upgrade the existing Peterhead-Persley-Kintore 275kV double circuit to 400kV including a new substation along its route; and install a higher capacity conductor on sections of the existing Kintore-Alyth-Kincardine 400kV double circuit**

Increase the capacity of the planned Peterhead to Longside (Peterhead 2) 400kV double circuit with a higher capacity 400kV double circuit; upgrade the existing Peterhead-Persley-Kintore 275kV double circuit to 400kV including a new substation along its route; and install a higher capacity conductor on sections of the existing Kintore-Alyth-Kincardine 400kV double circuit

Today's consultation also identifies SSEN Transmission as the delivery body for the Shetland Hub, DSUP and PKUP projects and we look forward to delivery confirmation of the remaining BKUP project in the coming weeks. The regulatory framework set out in today's publication enables the ongoing development of these critical network investments. They will also be subject to extensive public consultation to help inform the development of these new and upgraded network infrastructure requirements.

For the other projects in the north of Scotland included in the ESO's Beyond 2030' report, further assessment is necessary to determine the appropriate level of investment required to enable the full potential of ScotWind to be realised, including the most appropriate solution for the required north-south transfer of power.

SSEN Transmission Managing Director Rob McDonald said:

"We welcome the launch of Ofgem's consultation on the proposed Beyond 2030' grid enhancements which is the next step in determining how these essential projects can be taken forwards."

"Today's consultation launch reaffirms the need for these projects and underlines the importance of investment in the electricity transmission network to reach national energy targets, while also offering further clarity on our post-2030 growth plans."

"We hope this consultation will allow for an accelerated approach to regulatory financial frameworks so we can deliver on the new government's ambitious energy emission targets too."

"We now look forward to a timely decision from Ofgem and will continue to work constructively with the regulator and wider stakeholders to unlock the investment required for these vital projects to help us reach net zero."

Notes

- Ofgem's consultation is open until 30 August and is available to view on their website:

https://www.ofgem.gov.uk/consultation/proposed-regulatory-funding-and-approval-framework-onshore-transitional-centralised-strategic-network-plan-2-projects

J.D. POWER

SECRET TO A WELL-MANAGED UTILITY: STRONG BRAND APPEAL, J.D. POWER FINDS

August 7 , 2024

Do customers like doing business with their local gas and electric utilities, or merely tolerate them? Increasingly, the answer to that question determines how well utilities perform on virtually every customer management success metric from satisfaction and engagement, to trust and advocacy and support for rate increases. That's the major takeaway from two studies that evaluate the overall brand appeal of 234 electric and gas utilities in the United States: the J.D. Power 2024 U.S. Electric Utility Brand Appeal Index Study[SM] and the J.D. Power 2024 U.S. Gas Utility Brand Appeal Index Study[SM], both released today (July 24).

> *"Brand appeal has become a critical marker of a well-managed utility because it shows that the utility is going above and beyond to engage and connect with customers and, importantly, that their communications are aligning with the brand traits customers most value,"* ***said Chris Oberle, managing director of utilities intelligence at J.D. Power.*** *"The best utilities recognize that there is far more to building a strong reputation in their communities than simply providing reliable service. From leading on industry innovation, service quality and proactive customer interactions to being engaged in the communities they serve, utilities that cultivate a strong brand presence in their customers' lives are rewarded in several important ways."*

Following are some of the key findings of the 2024 studies:

- High brand appeal has benefits: Customers with strong brand appeal for their utility have an average overall satisfaction score that is more than 200 points higher (on a 1,000-point scale) than those with weak brand appeal. Utilities with appealing brands also enjoy higher customer loyalty; an increase in support for rate increases; and a significantly higher percentage of customers who believe the utility manages its financials well and are willing to advocate for the utility.
- **Trust is high, but reputation still needs work:** The customer trust score for electric utilities is 723 and for gas utilities is 751 both of which are up from a year ago. Despite these high scores for trust, however, company reputation scores for electric (655) and gas (674) utilities are the lowest of all factors evaluated in the study, suggesting that many utilities still have work to do building meaningful brands.
- **Gas utility brand appeal is stronger than electric utility brand appeal:** Gas utilities score an average of 717 on the overall Brand Appeal Index, an increase of 5 points from 2023. The average Brand Appeal Index score for electric utilities is 22 points lower at 695, a 2-point decline from a year ago. →

Study Rankings

Highest-ranking electric utilities in brand appeal by region and category are as follows:

East: **PSE&G** (733)

Midwest: **WPS** (728)

South: **EPB** (773)

West: **Clark Public Utilities** (761)

Cooperatives: **Walton EMC** (769)

Highest-ranking gas utilities in brand appeal by region are as follows:

East: **PSE&G** (750)

Midwest: **MidAmerican Energy** (754)

South: **Columbia Gas of Virginia** (751) and **TECO Peoples Gas** (751) in a tie

West: **Intermountain Gas Company** (742)

The Electric Utility Brand Appeal Index Study and Gas Utility Brand Appeal Index Study are each in their second year but are in their first year of being award eligible. The studies analyze how well U.S. utilities relate to their customers, evaluating the specific actions that influence overall brand experience, including company reputation, marketing execution and customer trust, among 149 electric utilities and 85 gas utilities. The index applies to all U.S. electric and natural gas utilities profiled in the J.D. Power Electric Utility Residential Customer Satisfaction Study^{SM} and the J.D. Power Gas Utility Residential Customer Satisfaction Study^{SM}. This year's studies captured the responses of 116,914 utility customers and were fielded from July 2023 through May 2024.

For more information about the Utility Brand Appeal Index studies, visit https://www.jdpower.com/business/utility-brand-appeal-index.

TAKING STEPS TO MITIGATE NATURAL DISASTERS FOR A MORE RESILIENT GRID

ELISABETH MONAGHAN
Editor in Chief

The articles in this Q3 issue of Electric Energy T&D Magazine, cover a range of topics or trends affecting the utility sector. Some of our subject matter experts suggest adopting programs to improve energy efficiency and workforce productivity or how to tackle some of the most difficult challenges utilities are currently facing.

Every one of the articles in this issue is insightful and reflects just how important it is for industry partners to share their best practices, so others may experience similar success. Other industry experts who contributed to this issue list steps utilities can take to avoid pitfalls they may have encountered.

For this column, I am focusing on three articles. The first is "Enhancing Grid Resilience: Sequential Strategies for Effective Wildfire Mitigation," which appears in our *Grid Transformation Forum* section of this issue; the second article, "Essential Factors for Managing Vegetation and Mitigating Outages with Unmanned Aircraft Systems," can be found in the *Green Ovations* section and the third, "Enhancing Utility Operations Through Technology Integration," is one of the guest editorials. I selected these three because combined, they demonstrate the interconnection between utilities and industry partners in the energy industry.

Wildfire Mitigation

According to an article written this past March by the Western Fire Chiefs Association, in the 1990s an average of 3.3 million acres burned per year due to approximately 78,600 fires. Since 2000, that number has more than doubled, with an annual average of 70,025 wildfires burning an annual average of 7.0 million acres.

Today's wildfire hazards have grown more significant. For example, the Park Fire near Chico, Calif., which ignited in late July, burned more than 360,000 acres in less than a week. In Ruidoso, N.M., the South Fork and Salt Fires, which both started on June 17, collectively burned nearly 25,000 acres. In Alberta Canada, a fire has ravaged Jasper National Park. As I write this, that fire continues to rage, and so far, at least 89,000 acres of land have been affected.

These are but a fraction of the fires that have ignited recently, and no doubt, there are more natural disasters looming as summer temperatures continue hitting historic highs.

In the *Grid Transformation Forum* section, Neil Placer and Michele Pastore from EnerNex, and Matthew Muthard and Jeff Hildreth from KEMA Laboratories point out how wildfires are becoming more intense and happening more frequently, which is taking a significant toll on the energy sector. Drawing upon their collective expertise, Placer, Pastore, Muthar and Hildreth lay out a series of strategies utilities should consider and steps they should take to manage and mitigate the risks that wildfires present.

In his article about using unmanned aircraft systems (UAS) to manage vegetation and mitigate outages, Cyberhawk's Matt Zafuto also writes about the damage wildfires and other natural disasters cause to the electric grid. In the past, utilities sent field workers to assess and repair this damage. Today, utility companies can access drone technology to visually inspect transmission towers and power lines at higher altitudes than any human worker can safely reach.

Zafuto goes on to make a strong case for why unmanned air systems, combined with visual data management software can lead to accelerated programs that drive growth, reduce costs and achieve sustainability targets. According to Zafuto, with the right synergy of hardware, software and services, utility companies can achieve operational excellence, enhance reliability and ensure resilience in a dynamic environment

This is a simple overview, but Zafuto's article provides detailed information, including specific steps and key considerations when deploying a UAS program for vegetation management and outage mitigation.

As if investing in new technology and establishing new processes to mitigate natural disasters and ensure a more resilient grid weren't a significant enough undertaking, utilities also must move forward with digitalization. Chad T. Hall with Panasonic Connect writes about enhancing utility operations through technology integration.

Hall explains that challenges like workforce shortages, aging infrastructure and ongoing cybersecurity threats underscore why utilities must take an integrated approach to digitalization, in which hardware, software and services are deployed "in a strategic, holistic manner to position utility companies for both immediate success and future growth."

For those utilities that have yet to embark or are just embarking on digitalization, Hall explains how, by integrating hardware, software, service and support, utility companies will see increased productivity and reduced downtime for utility workers while meeting their customers' demands "with agility and confidence and optimize operations for long-term success."

Each of us in the electric energy industry and the organizations we work for play some part in whether or not the entire energy sector succeeds in its push toward grid modernization and grid resiliency. As all of those who wrote for this issue demonstrate, by collaborating with other industry experts, and by pinpointing how utilities have either succeeded or failed in their efforts, we have an opportunity to ensure that our effort towards risk mitigation and recovery today means a modernized and resilient grid in the future.

Don't miss CIGRE Paris 2024!

If you attend CIGRE Paris Session 2024, you may run into our publisher Steven Desrochers. CIGRE Paris, which will take place from August 25 to 30 at the Palais des Congrès, is the leading global event for power system expertise.

Established in 1921 in Paris, France, CIGRE is a global community committed to the collaborative development and sharing of end-to-end power system expertise. The community features thousands of professionals from over 90 countries and 1250 member organisations, including some of the world's leading experts. At its heart are CIGRE's 61 in-country national committees, offering diverse technical perspectives and expertise from every corner of the globe.

For more information on CIGRE or CIGRE Paris Session 2024, visit https://www.cigre.org/GB/events/paris-session-2024.

As always, if you would like to contribute an article on an interesting project, please email me:

Elisabeth@ElectricEnergyOnline.com

Elisabeth

ENHANCING GRID RESILIENCE:
SEQUENTIAL STRATEGIES FOR EFFECTIVE WILDFIRE MITIGATION

NEIL PLACER, MICHELE PASTORE, ENERNEX

AND MATTHEW MUTHARD, JEFF HILDRETH, KEMA LABS

In this issue's Grid Transformation Forum, we hear from four industry experts — Neil Placer and Michele Pastore from EnerNex, and Matthew Muthard and Jeff Hildreth from KEMA Labs — on steps that must be taken to enhance the grid — especially when it comes to wildfire mitigation.

Wildfires are increasing in frequency and intensity, particularly in regions like California, posing significant challenges to the electric sector. Addressing these challenges requires a well-structured and strategic approach to wildfire mitigation. This article outlines a series of steps essential for enhancing grid resilience and ensuring public safety, focusing on the collective expertise and methodologies that can be adopted to manage and mitigate these risks effectively. →

1. Risk assessment and planning: Understanding our current context

Effective wildfire mitigation begins with comprehensive risk assessment and planning. This can be achieved by utilizing advanced data analytics and environmental monitoring tools, such as Predictive Analytics Geographic Information Systems (GIS). These tools are crucial for identifying high-risk areas, modeling fire behavior and potential vulnerabilities within the grid infrastructure. Thorough assessments are needed to evaluate the condition and placement of electrical infrastructure, which are vital in mitigating ignition risks. These efforts should be integrated into broader planning strategies that include data management, vegetation management, and proactive safety measures such as Public Safety Power Shutoff (PSPS) initiatives to prepare for and lessen potential wildfire risks.

2. Strategy development: Crafting our strategic plan

Developing a strategy is crucial to wildfire mitigation. One engineering consulting firm has collaborated with a major utility on the West Coast to form a specialized IT Design Office. This office is tasked with overseeing and managing a comprehensive suite of grid resiliency programs. By adopting this strategic approach, resources can be optimally allocated, leveraging predictive models and historical data.

3. Technology and innovation: Enhancing capabilities through innovation

Technological innovations play a fundamental role in advancing wildfire mitigation strategies. Predictive modeling and climate assessments, facilitated by digital twin technology, are at the forefront of forecasting and managing wildfire behaviors. These technologies are crucial for real-time asset management and grid hardening, providing utilities with insights into potential vulnerabilities and opportunities for strategic intervention. Incorporating these innovative tools enables more accurate forecasting of wildfire risks and enhances the effectiveness of mitigation measures.

4. Standards & protocols: Ensuring interoperability and compliance

Standards and protocols are essential in ensuring that all technologies and processes used in wildfire mitigation are interoperable and comply with industry norms. This includes rigorous adherence to safety and performance standards, which are critical in validating the effectiveness of mitigation strategies under real-world conditions. The development of architectures and management of grid resiliency programs involve ensuring that all components and strategies adhere to these crucial standards and protocols, facilitating seamless integration and functionality across different systems and technologies.

5. Testing and validation: Ensuring applicability and effectiveness

Testing and validation are crucial components of wildfire mitigation, ensuring that equipment not only meets technical safety standards but also complies with stringent regulatory and policy requirements. KEMA Labs' rigorous testing protocols, such as the CAL Fire exemption tests, play a pivotal role in demonstrating the safety and effectiveness of wildfire mitigation equipment under extreme conditions.

For instance, devices like the surge arrester with disconnect are subjected to rigorous conditions to verify their effectiveness in preventing ignition in high-risk areas. **Figure 1** demonstrates the type of equipment and method of testing to ensure that each component not only meets but exceeds the necessary safety standards for wildfire mitigation. These tests are essential for certifying devices like fire protection disconnectors, ensuring they can effectively prevent the ignition of flammable materials around electrical infrastructure. Successfully passing these tests allows such devices to be certified for use in high-risk areas, aligning with both state and federal regulations aimed at reducing wildfire risks.

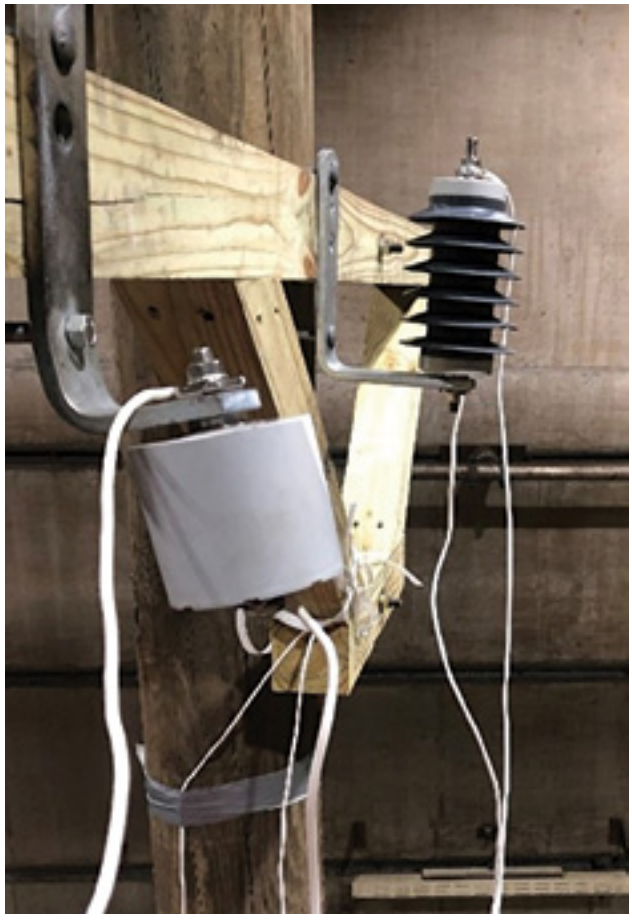


Figure 1 Surge arrester with disconnect.
Source: KEMA Labs - Chalfont

Figure 2 Overview of the whole testing setup.
Source: KEMA Labs - Chalfont

In addition to individual equipment tests, comprehensive testing setups like the one pictured in **Figure 2** are essential for simulating real-world conditions and ensuring the overall effectiveness of wildfire mitigation strategies. Centered in the photo is a pole equipped with the arrester and disconnect; to the left, the supply connection that powers the setup; on the right, the fans used to simulate wind conditions during testing; and at the bottom, a fuel bed that mimics the ground materials found in wildfire-prone areas. This setup allows for a holistic testing environment that ensures every component functions as expected under the most challenging conditions.

At the policy level, manufacturers must navigate a complex regulatory landscape that dictates everything from equipment design to performance benchmarks. Past disasters, ongoing research and a pressing need to address public safety and environmental concerns often shape these policies. Manufacturers must ensure that their products not only adhere to current safety and environmental standards but are also capable of meeting the requirements of anticipated regulatory changes. This proactive engagement with policy and regulatory frameworks helps manufacturers design and produce equipment that is effective at mitigating wildfires and compliant with ever-evolving standards. It ensures that third-party products can sustainably serve the needs of utilities, help utilities meet their compliance obligations and contribute to broader public safety and environmental objectives. →

6. Certification and compliance: Establishing trust through certification

Implementing wildfire mitigation strategies involves the deployment of carefully developed and tested technologies and procedures. This stage is critical for applying theoretical plans in practical settings, including the integration of certified equipment and the activation of emergency preparedness protocols. The process of obtaining appropriately accredited equipment and technically sound testing procedures ensures that all prepared measures function cohesively to enhance the resilience of electrical grids and improve the readiness of communities and utility services in responding effectively to wildfire emergencies.

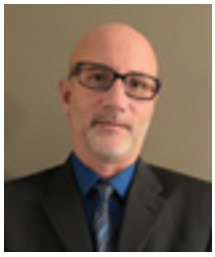
7. Implementation: Executing the plan

The practical application of developed strategies and technologies is critical. This phase includes the deployment of certified equipment and the execution of comprehensive emergency preparedness plans. It is essential to ensure that mitigation strategies are implemented and integrated across various grid resiliency projects effectively.

8. Continuous improvement: Advancing the approach

Continuous improvement in wildfire mitigation is not merely a recommendation — it is a necessity. As conditions change and new data becomes available, utilities must reassess and refine their strategies to ensure their strategic procedure remains effective. The comprehensive graphic illustrates the sequential framework for effective wildfire mitigation across utility services. By continually refining and updating wildfire mitigation strategies, utilities not only address the immediate challenges posed by increasingly frequent and intense wildfires but also enhance the long-term resilience and safety of electric grids, keeping pace with evolving environmental and technological landscapes.

Addressing the complex challenges of wildfire mitigation requires a disciplined approach, encompassing several critical stages of planning and execution. Initially, the focus is on understanding the risk landscape through comprehensive assessment and strategic planning. Establishing a firm foundation supports the development of targeted strategies that leverage innovative technologies to predict and manage wildfire risks effectively. During the middle stages, the targeted strategies undergo rigorous testing and validation to ensure they meet high safety and performance standards. Finally, these strategies are put into action in the implementation phase, closely followed by continuous monitoring and iterative improvements to adapt to new insights and evolving conditions. Throughout the steps of testing and implementation, the integration of specialized expertise is crucial in refining and advancing wildfire mitigation strategies to enhance grid resilience and public safety effectively.



ABOUT THE AUTHORS:

Neil Placer serves as the director of Utility Consulting Services at EnerNex, bringing over two decades of specialized expertise in the electric utility sector. His contributions at EnerNex have significantly impacted major projects, including the development of grid resiliency architectures and leading grid modernization efforts for several large utilities in the United States.

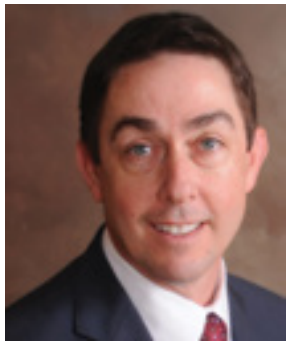
Michele Pastore, chief business strategy officer at EnerNex, excels in strategy, company management and business development. His experience spans engineering, design, and operations of renewable and traditional generating facilities, as well as transmission and distribution infrastructure – with projects across North and Central America, Europe, the Middle East and Africa.

Matthew Muthard is an accomplished electrical engineer and area manager for North America at KEMA Labs, a role he has held since March 2020. With a robust career spanning over 27 years, Muthard has demonstrated profound expertise and leadership in the engineering sector. He holds a Bachelor of Science in electrical engineering from Pennsylvania State University.

Jeff Hildreth is the lab director at the KEMA Labs location in Chalfont, Pennsylvania. Before joining KEMA, Hildreth worked for more than two decades in the electric utility industry, specializing in laboratory and field commissioning of power system equipment.

ESSENTIAL FACTORS FOR MANAGING VEGETATION AND MITIGATING OUTAGES WITH UNMANNED AIRCRAFT SYSTEMS

Visual data management software and cloud-based services are essential to proper management and organization of terabytes of high-resolution images, thermal readings, satellite information and 3D models.



MATT ZAFUTO

Motivated to improve inspection safety, efficiency and accuracy in evaluating power lines, poles, transformers and other energy infrastructure components, utilities began experimenting and utilizing drones to inspect distributed assets in the early to mid-2010s. Even the early results surpassed the efficiency and accuracy capabilities of ground crews and helicopters. By employing unmanned aerial systems (UAS) equipped with cameras and sensors, utilities could access difficult-to-reach areas to collect detailed visual data, allowing for more informed maintenance and repair decisions and timing. Until about 2019, utilities across the U.S. had a more ad hoc, piecemeal approach to asset inspection. However, increasing concerns about aging infrastructure and environmental events have prompted utilities, especially in the fire-prone Western states, to develop more holistic, proactive and sustainable approaches.

Fast forward to today, the risk/reward is substantially higher, with more than 5.5 million line-miles more than 180 million power poles in the U.S. (Dept. of Energy). With ongoing environmental events, an average of 1.7 million acres burned in July of each year from 2002 to 2020, according to the Environmental Protection Agency (EPA), adding serious concern for an already stressed grid. In California alone, lightning strikes caused wildfires that burned more than one million acres in 2020 – making vegetation management a top priority.

Wildfires, hurricanes and other natural disasters can wreak havoc on utility facilities, damaging towers, power lines and other equipment in the blink of an eye. To repair this damage as quickly as possible, utilities need to ensure all their assets are safe from high winds or fallen trees before sending in their workers or launching repair missions from the ground. As drone technology becomes increasingly sophisticated and affordable, many utility companies are using drones to visually inspect towers and power lines at higher altitudes than any human worker can safely reach. →

Improvements in drone technology include advanced cameras and sensors that enable high-resolution data capture, which facilitates acquiring more images while keeping ground crew out of dangerous situations.

Utilities are under more pressure than ever. They must balance safety and productivity as well as customer satisfaction, profitability and environmental stewardship. Moreover, they're tasked with managing a grid that wasn't originally designed to handle increasing complexity of energy flow and consumption as well as the evolving needs of the communities and businesses they serve.

Fortunately, there have been significant technical advancements in both hardware and software. State-of-the-art drones now come equipped with advanced cameras and sensors. These include corona detection capabilities and high-resolution data capture imaging. Coupling this technology with Visual Data Management software enables substantial speed and savings when utilizing UAS programs for vegetation management and outage mitigation. In addition, recent advances in beyond-line-of-site (BVLOS) operations allow drones to fly greater distances and capture more data while keeping ground crew out of dangerous situations.

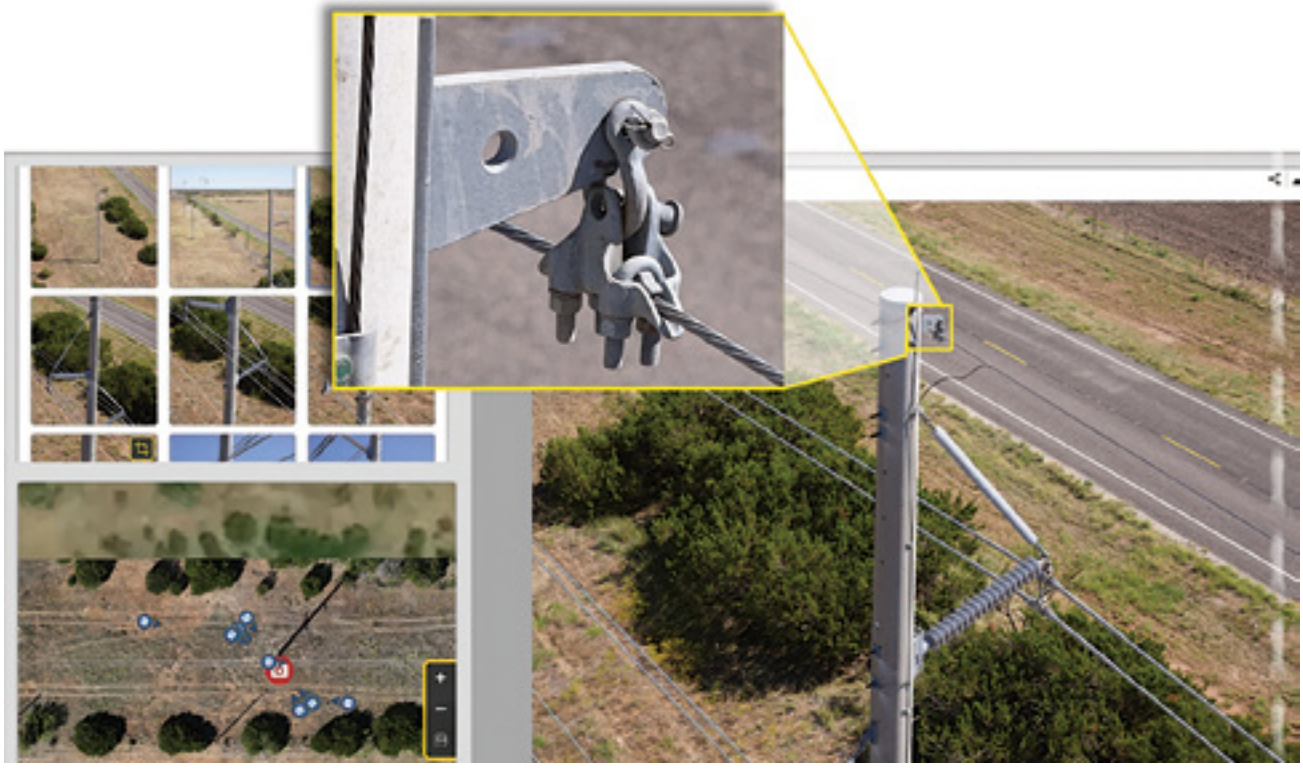
Managing visual data at scale

The capture and handling of mass amounts of critical data can make or break the success of drone-based inspections. Properly managing and organizing terabytes of high-resolution images, thermal readings, satellite and 3D models is vital. It is central to operational teams' ability to manage inspections, maintenance, safety and compliance. It's not uncommon for inspection teams to collectively capture 1,000 images per day that must be organized, reviewed, encrypted and submitted to the utility for analysis.

Visualization software — some incorporating AI capabilities — provides actionable insights and unprecedented levels of access to terabytes of multi-level data. With visual data at their fingertips and in the cloud, utility engineering and operation and maintenance teams can instantly gain a comprehensive visual understanding of their transmission lines, substations and switching substations. The in-depth visual and thermal analyses expose integrity vulnerabilities and reveal potential improvement opportunities. This significantly reduces safety risks, downtime, environmental impact, and costs.

It enhances inspection speed and dramatically minimizes the need for linemen to work at height, near live lines or in generally hazardous areas. In addition to Visual Data Management, today's UAS programs are revolutionizing the inspection of utility assets through automated processes in several ways:

- **Pre-programmed flight paths:** Drones can be programmed with predefined flight paths using GIS/GPS waypoints. This automation allows them to fly over designated areas, inspecting utility assets systematically without requiring continuous manual control.
- **Autonomous navigation:** Advanced drones are equipped with obstacle detection and avoidance systems, enabling them to navigate around obstacles such as buildings, trees or power lines autonomously. This capacity ensures safe and efficient inspections, even in demanding conditions, bolstering system, operator and community safety while also minimizing time, resources and costs.
- **Remote monitoring and control:** Operators can remotely monitor and control drones in real-time using specialized software or applications. They can adjust flight parameters, camera settings and inspection routes as needed, ensuring flexibility and responsiveness during the inspection process. Moreover, with BVLOS waivers, the UAS can go farther into a territory to inspect assets quickly.
- **Sensor integration:** Drones can be equipped with various sensors, including visual, thermal, LiDAR and Corona. These sensors capture detailed data about assets, such as power lines, poles, transformers and wind turbines, allowing for comprehensive inspection and analysis.
- **Reporting and documentation:** Automated drone inspections generate detailed reports and documentation, including inspection findings, asset conditions and recommended actions. These reports can be automatically generated and shared with relevant stakeholders, streamlining workflow and decision-making processes to ensure compliance with regulatory requirements while decreasing unnecessary truck rolls.
- **Data integration:** Using open information architectures, users can leverage investments in related data sets such as GIS and most mainstream data sets. In fact, easy bi-directional integration of important intelligence — like that from GIS — can enhance inspections while at the same time ensuring maximum fidelity in the GIS data. →



Aerial views coupled with GIS intelligence allow targeted image capture with high enough resolution to rapidly facilitate detailed defect identification that was previously impossible with ground inspections or lower resolution imagery, saving utilities millions of dollars in maintenance and forced outage avoidance.

With these advancements, the latest innovation focuses on enhancing automation, taking it a step further to deliver the benefits that the industry seeks. These benefits include better collection of data, more data sources and additional data types giving utilities more granular insight into their assets. This process with democratized data has impacts throughout the value chain. For example, operators can use sophisticated software data collection specific to a particular payload and a specific drone to optimize assessments. This data can be quickly processed using AI and machine learning algorithms to identify defects, anomalies or potential issues with distributed assets, saving substantial time and costs. In fact, a major utility in California has achieved $180 million in savings with its UAS programs by deferral of work due to higher accuracy inspections. Evaluation programs in smaller utilities have shown OPEX reductions of more than 25% just by leveraging drone technology and Visual Data Management solutions. When projected over their entire service territories, they anticipate tens of millions of dollars in savings.

Developing the most effective process

When inspecting transmission and distribution assets, developing an efficient process is critical. Often, a UAS program may begin with surveying only a few hundred assets each month and then need to ramp up to meet the utilities' requirements effectively. Putting the right processes in place will facilitate efficiencies in planning, forecasting and logistics regardless of the size of the asset territory. Many small drone operators using temporary contract pilots simply can't keep up with the required quality or quantity of work – especially at scale.

Typically, a two-person inspection crew includes a drone pilot and a payload or sensor operator responsible for capturing the data. It's important to note that not all inspection firms have a dedicated sensor operator, as it can be more expensive because it takes more resources, training and management. However, this is a very thorough way to operate and ensures the highest quality data. By avoiding reflights, the UAS vendor can better maintain schedules and cover more critical territory. Although drones have made it possible to survey areas that have been very difficult to reach, in cases where terrain, distance or urgency make drone use unfeasible, a request for a helicopter inspection can be triggered for supplemental support.

High fire danger regions typically require annual inspections while lower-risk areas and areas with newer assets may be inspected with less frequency. It is not uncommon for a utility to make special inspection requests when needed in vulnerable areas or as a response to customer reports. When evaluating a UAS partner, look to see if they have offroad vehicles outfitted with a variety of drone equipment with ruggedized construction, high-quality lenses and specialized weights that are best suited for the often remote areas where they will perform their inspections. Verify whether they have established a protocol for capturing hundreds of images per structure to evaluate the maintenance requirements of each asset. The reliability of the data capture process and its swift delivery to the utility's asset management team are crucial.

Key considerations when deploying a UAS program for vegetation management and outage mitigation

Because visual site inspections using UAS is still a relatively new field, many UAS providers have tended to be smaller operations using freelance pilots who have obtained training for the FAA's Small UAS Rule (known as Part 107) test implemented in 2016. This was a simplification of previous FAA requirements that had not yet evolved to specifically address drones. Current training courses to prepare students for this written theory test certification can range from 2-hour online programs costing as little as $50 to 4-year university aviation degree programs.

While FAA Part 107 is the baseline certification necessary to commercially operate a drone, it is only a theory test, and its requirements do not begin to encompass the specific skills needed to meet exacting standards. Depending upon their previous practical experience, to reach "entry-level" competence for utility UAS inspections, Part 107-certified pilots will typically start practicing with small drones and a DGI (Digital Geographic Information) platform before moving to practice on working utility assets.

When beginning to work on utility assets new pilots are partnered with a senior pilot who emphasizes safety, risk mitigation, asset identification and communication skills that are vital to operational success. They must pass both summative and formative assessments culminating in a practical test performed on a live asset demonstrating their ability to conduct a dynamic risk assessment, team debriefing, communicate safety factors from possible interference, perform the aerial inspection, and complete the operation in a safe manner.

However, there are other critical areas to consider, such as the program's objectives and desired outcomes. Starting from the desired result and working backward helps determine the initial steps needed. Many utilities can benefit from not treating these programs as mutually exclusive. When the UAS program, for instance, is seen as separate from vegetation management or asset management, its effectiveness diminishes. A holistic UAS program can address all these utility needs and benefit from democratizing data across departments, including asset inspection, vegetation management and legal. When everyone has access to the same information, specific departmental decisions can be made more effectively.

Conclusion

The rapid advancement of technology in recent years has paved the way for innovative approaches to inspecting and managing transmission and distribution assets in the utility industry. Integrating drones, Visual Data Management, AI and streamlined inspection workflows enhance efficiency, accuracy and safety. This integration facilitates critical infrastructure inspection for vegetation management and outage mitigation. Ultimately, the industry will increasingly embrace drone automation and Visual Data Management software, saving substantial OPEX costs.

ABOUT THE AUTHOR:

Matt Zafuto has been a catalyst for improving T&D grid operations and leader in corporate and industry change for the past 30 years. During this time, he has focused on driving business process changes with technology innovations in energy utility operations to address reliability and workforce efficiency. Zafuto's career highlights include establishing and executing strategy at the corporate level, aligning line of business objectives to the corporate strategy and tactical execution of strategic objectives at Fortune 500 companies such as IBM, ABB and Xcel Energy and most recently, as Chief Commercial Officer for Cyberhawk.

POWER QUALITY IN LOW VOLTAGE AREAS:

THE NETHERLANDS' ENERGY TRANSITION RELIES ON SOPHISTICATED REMOTE TELEMETRY SYSTEMS

RONALD ROBBERTSEN

"While God created the Earth, the Dutch created the Netherlands," goes the old saying — referring to how the country's first settlers from around 400 BCE built the country from earth mounds and dikes to hold back the waters of the North Sea. Now, the country is building a smart grid infrastructure to move away from traditional energy sources to renewables. To overcome the challenges of monitoring these medium-voltage renewable energy sources, Juva, an energy network management company turned to remote telemetry as a solution.

Transitioning to a low-carbon energy system is now the primary focus of Dutch energy policy, according to the International Energy Agency. The Netherlands' 2019 Climate Act has set legally binding targets to reduce greenhouse gas (GHG) emissions by 2050. First, to reduce emissions to 95%, compared with 1990's levels and, second, for 100% of electricity to come from renewables by that year.

As reported by Reuters, the country also faces pressure to bring its end date forward to 2030 following COP26. Wind, wave, marine, hydro, biomass and solar are all proving themselves as viable alternative energy sources — but finding the right control technology to monitor these sources effectively presents a challenge for smart grid operators.

First, to reduce emissions to 95% compared with 1990's levels and, second, for 100% of electricity to come from renewables by that year.

Effectively managing assets on a smart grid is only achievable through the capture, storage and interpretation of vast amounts of data from physical assets. However, renewable energy sources like solar rely on low- or medium-voltages, and monitoring these can be more challenging. Renewable sources are unpredictable. For instance, because the sun shines at certain times, solar panels feed energy back into the grid periodically which can lead to potential instabilities and disruptions in the grid. What's more, conventional remote monitoring systems — aside from being expensive — can be ill-suited to the task of properly interpreting the fluctuating performance data. →

Finding the right control technology for renewable energy sources is a challenge for smart grid operators. Source: Ovarro

Dutch homes are increasingly turning to renewable energy sources, like solar panels. Source: Ovarro

These were the challenges faced by energy management company Juva with the grid operator Westland Infra on distribution automation. Together, they manage a smart grid covering an area of 25 to 30 square kilometres in Westland, the Netherlands, which involves monitoring around 250 substations in the region. Juva sought a better solution for remote monitoring and managing low- and medium-voltages on the grid.

This need was getting bigger as more and more Dutch homes turned to renewable energy sources, like solar panels. Whereas photovoltaic systems accounted for just 0.05%, or 56 gigawatt hours (GWh), of the Netherlands' total energy consumption 10 years ago, this figure had risen to 6.79%, or 8,144 GWh by 2020.

Outside the box

"We needed a flexible, customisable solution to handle the requirements typical of low- or medium-voltage networks," says Roel van de Konijnenburg, operations technology specialist at Juva. "We found that monitoring and control technology platforms from other suppliers tend to focus on a standard template."

Juva was facing limitations with its existing systems. Changes to drives and operating systems were time-consuming and could be difficult to implement. Instead, Juva wanted a solution that would go beyond the normal boundaries — that was secure, cost-effective and could handle the unpredictable behaviours of renewable energy sources.

To find this, Juva turned to a trusted partner that could supply, configure and implement medium-voltage network telemetry systems for grid operations. The companies had worked together on all kinds of projects including for the monitoring and controlling of protection relays, energy meters and remote switching of medium-voltage fields. Juva required that the partner be flexible with implementation and easier to work with as a result.

A consistent supply

To investigate how to implement a consistent medium-voltage energy supply across the smart grid, it was necessary to examine some of the key challenges. That included issues relating to the three-phase grid, which is the world's most common and economical way of alternating current power generation, transmission and distribution across a network.

Juva recognised that low-voltage solar panels of various households in a neighbourhood were not equally distributed over the three-phase grid. In another instance, a wire in the cable was overloaded due to the high level of sunlight. Consequently, the grid operator needed a solution with flexibility to detect these unique instances. Existing hardware also made it difficult to detect instances of illegal energy use. In short, technology was needed that would help Juva manage its grid productivity, energy efficiency and security with higher levels of quality of service (QoS).

Next, a third company was brought into the project with expertise in specially designed smart sensor networks, data analytics and unique collaborative software to better analyse and control data on grids.

A solution was devised with Rogowski coils. Rogowski coils are commonly used to accurately monitor medium- and low-voltages in precision welding systems, arc melting furnaces, short-circuit testing of electric generators and as sensors in protection systems of electrical plants. The installation time was reduced to less than 30 minutes to measure eight fields, and the purchase price was also much cheaper than conventional solutions.

Remote telemetry units (RTUs) designed to offer flexibility and maximum security for the water, energy and industrial markets. Source: Ovarro

Aside from the Rogowski coils, remote telemetry unit (RTU) systems were needed for the capture, storage and interpretation of vast amounts of data from physical assets in the network. RTUs are now a critical part of most power generation and distribution operations, and are essential for smart grids today and in the future. They are used in a range of water, energy and industrial applications with two main design principles: flexibility and maximum security.

Flexibility and security

Flexible characteristics of the RTUs include their ability to implement a variety of protocols in real-time including IEC104, COAP and Modbus, with other protocols available on request. New protocols can be created easily through the Linux operating platform and C# programming language, while programmable logic controller (PLC) programs can also be made with the latest standard from Codesys based on IEC61131-3 — this standard is the industrial protocol for control programs and is used by many national and international organisations and companies.

The RTUs greatly benefit the overall security of the network, adds Konijnenburg: "The hardware and software of the RTU is a definite improvement. You can connect multiple networks in a station — one port is used for communications upwards and another for substation communications. We use a lot of firewall functions to protect these many inputs/outputs (I/Os). The security options aren't limitless, but there are many."

Remote telemetry systems like these will prove vital as more homes and businesses in the Netherlands turn to low- and medium-voltage renewable energy sources, and as Juva expands its smart grid and the number of substations beyond the 250 it monitors currently. Just as the Dutch created the Netherlands all those years ago, the country is now on its way to creating a fully sustainable energy grid by 2050 — if not sooner.

ABOUT THE AUTHOR:

Ronald Robbertsen is a project engineer at Ovarro, where he has dedicated over 33 years to the company. He studied technical iInformation at HBO University and is based in the Netherlands. Robbertsen's extensive experience and technical expertise has been instrumental in advancing Ovarro's engineering projects.

MEDIUM VOLTAGE IN THE AGE OF DIGITIZATION:

NAVIGATING MV TRENDS IN THE U.S.

MELTON CHANG

In the ever-evolving landscape of electrical distribution equipment, the demand for medium voltage (MV) solutions is on the rise, particularly in electro-intensive industries such as data centers, oil and gas, semiconductor manufacturing and e-mobility. In addition to the rise of medium voltage applications, there is also a demand for more digitization in equipment, providing end users with increased visibility into equipment status and proactive maintenance, as well as an increased focus on sustainable solutions.

The rising demand for medium voltage in electro-intensive industries

The increase of electro-intensive industries within the U.S. market has significantly propelled the demand for medium voltage (MV) solutions. These industries, characterized by their substantial energy requirements, encompass data centers, oil and gas operations, semiconductor manufacturing and e-mobility. Each of these fields requires not only higher incoming power but also reliable, efficient distribution of power to maintain uninterrupted operations, spotlighting the critical nature of MV systems in supporting the backbone of modern infrastructure and technological advancements.

In addition to the increase of new construction of these facilities, there is also an increase of medium voltage equipment at these facilities as well as an increase of voltage and ratings required both at the incoming and through the facility. Additionally, the rise of what is referred to as the new energy landscape is also leading to increased focus on medium voltage intertwined with renewable resources. The new energy landscape consists of new forms of energy generation, storage and usage, including wind and solar generation, DC energy and micro-grids.

Specifically, data centers, semi-con and e-mobility emphasize the strong shift in energy demand, these segments are not only having historic growth, but they also seeing an increase in MV usage in their new construction projects. In the context of data centers, the exponential growth of digital data consumption and cloud services has led to major data purchasers and handlers announcing new data center development, with many projects including several phases that stretch over a decade in development. Similarly, semiconductor manufacturing, a cornerstone of the digital age, has seen an increased focus after shortages experienced in 2020, leading to the construction announcements for US-based manufacturing such as Intel's 2022 announcement in Ohio. Additionally, the rise of e-mobility and fleet charging, underscored by the global shift towards electric vehicles being adopted at several global logistics and transportation companies such as FedEx, Amazon and facilities such as Heathrow Airport, has introduced a new dimension to the new energy landscape, further stressing the importance of resilient MV infrastructure to support charging networks and related facilities. →

Digitization: The path to increased reliability and visibility

Faster access to information, quicker service and digital connectivity are not new trends for many global industries, but electrical distribution equipment may be the final frontier of digitization. The transformative power of digitization within the medium voltage landscape is revolutionizing how facility operators approach asset management and maintenance. Through the implementation of cutting-edge digital tools, the sector is witnessing an unprecedented increase in both the reliability and visibility of crucial MV equipment. Central to this advancement is the deployment of sophisticated monitoring systems that harness the potential of the Internet of Things (IoT) and cloud-based technologies. These systems provide a comprehensive view of an asset's health in real time, allowing for the early detection of irregularities that could lead to system failures.

Leveraging data analytics, end users can assess maintenance needs with remarkable accuracy, shifting from reactive to proactive maintenance cycles. This not only ensures the optimal performance of MV assets but also significantly reduces operational costs associated with unplanned downtimes, while also making maintenance procedures more efficient. The integration of digital technologies into MV solutions facilitates remote diagnostics and control, enabling maintenance teams to address issues without the need to be physically present at the site. This capability is particularly invaluable in challenging environments where access is limited or in situations that require immediate response to prevent extensive disruptions.

Moreover, the digitization of MV assets lays the foundation for a smarter power grid — one that can seamlessly adapt to changes in demand and integrate renewable energy sources more effectively. By enhancing the connectivity between various components of the power distribution network, digitization ensures that engineers have a 360-degree view of operations at all times. This interconnectedness not only bolsters the resilience of the power grid but also empowers operators to make informed decisions based on comprehensive data, thereby optimizing energy consumption and minimizing environmental impact.

As we advance further into the digital era, the role of digitization in transforming the MV sector will only grow more critical, offering innovative solutions to age-old challenges and paving the way for a more reliable, efficient and sustainable future.

Continuous health monitoring and integrated controls in MV metal-clad switchgear

The integration of continuous health monitoring and integrated controls into MV metal-clad switchgear represents a transformative leap forward in medium voltage power distribution. This innovative approach leverages the latest in sensor technology and digital analytics to provide real-time insights into the operational health of switchgear. By continuously monitoring key parameters such as temperature, humidity and critical components inside the circuit breaker itself, potential issues can be identified and addressed before they escalate into failures, ensuring uninterrupted power supply and enhancing overall system reliability.

The application of integrated controls further enhances efficiency as well as reliability by ensuring operator safety by removing allowing remote operations. This not only optimizes the performance of the switchgear but also significantly reduces the operator. As we move towards a more digitized and interconnected energy landscape, the potential of continuous health monitoring combined with predictive analytics through cloud software systems and integrated controls in maintaining and improving system integrity cannot be overstated, marking a new era in medium voltage solutions.

Sustainability as a key factor for innovation

The accelerated push towards sustainability will continue to drive innovation. The electrical distribution industry is at a critical juncture, with new regulations and sustainability standards reshaping the way companies design electrical systems, manufacture equipment and utilize MV solutions. These regulatory changes are driven by an urgent need to address climate change and reduce greenhouse gas emissions, asking all involved in the lifecycle of equipment to be cognizant and active in their sustainability initiatives.

Previously I touched on the importance digital will play in the evolution of switchgear, and one facet that will be heavily influenced by digital technologies will be enabling sustainable practices. Through sophisticated data analytics, IoT and other digital tools, industries can gain unprecedented insights into their operations, identifying areas for improvement in energy efficiency, resource management and waste reduction. This digital layer not only enhances operational transparency but also empowers businesses to implement more sustainable practices with greater precision and impact. It can allow them to be more efficient about their equipment usage and ensure it is operating at its peak performance, as well as provide insight into potential wear that could risk the integrity of the breaker itself. By enabling more preventive action around the maintenance of equipment, end users can decrease the chance of premature equipment replacement.

As the global focus intensifies on reducing greenhouse gas emissions and combating climate change, the medium voltage (MV) industry faces a significant challenge due to the widespread use of sulfur hexafluoride (SF6) in gas-insulated switchgear (GIS). Known for its excellent insulating and arc-quenching properties, SF6 has been a cornerstone in the development of MV infrastructure. However, its classification as a potent greenhouse gas, with a global warming potential thousands of times greater than that of carbon dioxide, has spurred a concerted effort to find sustainable alternatives. This endeavor is not just driven by regulatory pressures, including stringent emissions targets and potential bans on SF6, but also by a collective industry commitment to environmental stewardship.

Innovators and engineers across the sector are now actively exploring and developing SF6-free technologies that promise comparable or even enhanced performance without environmental drawbacks. These alternatives include air-insulated switchgear (AIS) that employs vacuum technology and solid insulation materials to eliminate the need for SF6. The transition to SF6-free solutions reflects a broader industry shift towards sustainability, aligning with global environmental goals and consumer expectations for more eco-friendly energy solutions.

However, the dichotomy between the environmental implications of SF6 and the operational benefits of SF6 GIS necessitates a balanced approach, exploring innovative solutions that can deliver the reliability and efficiency of SF6 GIS without its environmental drawbacks. As the industry grapples with this challenge, the quest for sustainable, high-performance alternatives to SF6 in GIS applications becomes increasingly crucial, driving research and development efforts across the sector.

Rethinking manufacturing

In the realm of industrial operations, the pivot towards sustainable manufacturing processes is not just an environmental imperative but a strategic business decision. This shift reflects a comprehensive approach to minimizing the ecological footprint of production while bolstering efficiency and future-proofing businesses against evolving regulatory landscapes. In this transition, the focus extends beyond mere compliance to a proactive embrace of eco-friendly practices that transform every facet of manufacturing, from raw material sourcing to end-product delivery.

Central to this sustainable overhaul is the optimization of material usage. By critically assessing and redesigning production lines, industries can significantly reduce waste, thereby conserving resources and mitigating the environmental impact of their operations. This entails not only the prudent selection and use of raw materials but also the adoption of manufacturing technologies that enhance material efficiency. The integration of advanced automation and precision engineering tools enables industries to achieve tighter control over their processes, minimizing excess and optimizing the use of resources.

Moreover, the adoption of green packaging solutions represents another vital aspect of sustainable manufacturing. Moving away from single-use plastics and non-recyclable materials to biodegradable, recycled and recyclable options not only reduces the environmental toll of packaging but also aligns with the growing consumer demand for sustainable products. This transition, while challenging, offers a compelling opportunity for industries to lead in innovation and sustainability.

As industries embark on this journey towards sustainable manufacturing, the benefits extend beyond environmental conservation. They encompass improved operational efficiency and reduced costs. This comprehensive approach to sustainability in manufacturing processes underscores a commitment to innovation, efficiency and environmental stewardship that will define the industrial leaders of tomorrow.

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Melton Chang serves as the SVP of Schneider Electric and the head of the global Medium Voltage Line of Business in the Energy Management Division. He is in charge of the overall R&D, quality assurance and marketing of Medium Voltage Line of Business, as well as the planning of global multi-hub business strategy, and leads the organizational transformation to enable agile development. Joining Schneider Electric in 2007, Chang has worked in North America, Taiwan, Shanghai and France. He has extensive experience in driving organizational and strategic development.

ACCELERATING CHANGE

IN A TRANSFORMATIVE ENVIRONMENT

GAURAV GUPTA

The energy industry is in the midst of significant changes with a record amount of capital flowing into establishing new energy sources and transforming the grid's infrastructure. The Biden-Harris administration's Federal-State Modern Grid Deployment Initiative is the latest effort to accelerate grid modernization. With the demand for electricity forecasted to triple by 2050, ambitious de-carbonization efforts in progress, and the continued impact of climate change on weather increasing, utilities are faced with the need to transform how they generate electricity and deliver it and engage with their stakeholders.

Transformation of this scale requires a deliberate approach that can tap into the energy of employees across the organization rather than relying on only a few individuals. Organizations that can create more engagement and leadership from their employees will be best suited to take advantage of the opportunities presented by new legislation and the shifting energy landscape. To accelerate programs that drive growth, reduce costs and achieve sustainability targets, leaders will need to do the following:

Build a committed, engaged workforce: In uncertain and fast-changing contexts, making good decisions and fast progress requires a workforce that is aligned and engaged. Leaders can build commitment in the organization by clarifying the "why" behind necessary changes. Helping employees at all levels of the organization understand why changes in the ways of working are necessary, why these changes are required now and what benefits will be achieved through these changes allows them to identify how they can participate and contribute to the various initiatives.

Utilities have experienced the value of this aligned and focused engagement in their storm responses, during which groups of employees are able to collaborate and coordinate with speed because the "why" is clear and the skills are well practiced. Leaders can create more of this empowered action by ensuring that employees have clarity on the organizational direction by explicitly articulating the opportunities in front of them and by investing in their employee's leadership and change skills. →

Remove barriers to change: Organizational systems are not designed for change – "that's how we have always done it" is an implicit mindset for most of our management routines. Encouraging innovation and adaptability requires challenging things, even those that are working, to find ways to make them better. This requires leaders to encourage experimentation, reward good failures and make it easier for employees to act on new ideas. As an example, policies that require layers and layers of approvals can unnecessarily slow down project development. Periodically reassessing these policies to ensure that they are limited to the high-risk, regulatory or legal concerns and not operational concerns (which can be better handled through a principle, not policy-based approach) is one way to remove barriers. Systems, processes and ways of working can all inhibit action if they are not aligned with the behaviors desired in the organization. For example, if innovation and agility are not recognized and rewarded in hiring and performance systems, it is not a behavior that employees will embrace. If the reporting and documenting requirements for even small changes are too detailed, individuals will be reluctant to try new things. If budget accuracy is the primary focus, stretch targets and new ideas are unlikely to be the norm. Leaders can accelerate progress by assessing and evolving systems and processes that are creating barriers to the desired ways of working.

Maintain forward movement: Multi-year and multi-faceted transformations can lead to fatigue if individuals don't feel that they are making an impact. Celebrating success along the way and ensuring clear tangible wins are being communicated across the organization will help build momentum for sustained action. This sense of momentum can be engineered by designing initiatives that rely on pilot projects, interim milestones and proof of concepts to show early impact. Momentum can also be created by stopping to celebrate successes along the way. For example, when new projects pass certain gates, when teams hit leading indicators or when experiments fail but result in new and meaningful learning. Understandably, in an environment that requires a lot of change, the desire to move on to the next challenge can be strong, but leaders must recognize that building organizational stamina for longer-term change requires pausing to celebrate short-term wins.

Momentum can also be created by stopping to celebrate successes along the way.

The energy industry is facing more opportunities and challenges than at any point in recent history. Taking advantage of these opportunities will require changes to how these companies operate. No individual leader or small group of leaders can make all the decisions required to be successful. However, a committed workforce that is empowered to act can make decisions and act on the front lines to address threats and capitalize on emerging opportunities.

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TRANSMISSION GRID OPERATORS NEED TO FUEL THE ECONOMY – WITH OR WITHOUT GOVERNMENT REGULATIONS

JØRGEN FESTERVOLL

Transmission grid operators aren't just transporting the electricity that lights up people's homes and streets. They're fueling the growth of the entire economy. After all, economic growth always comes down to energy, and the transmission grid is the backbone of any modern economy.

Building a new city? You need the grid. Powering electric vehicles? You need the grid. Deploying data centers or artificial intelligence to create new efficiencies? You need the grid. The list goes on.

Those of us who work in the industry know that there are looming issues facing ratepayers and continued economic growth, as power grids across the U.S. are struggling to keep up with the increasing demand. Massive electrification of the economy combined with extreme weather incidents are pushing power grids to their limits. And the challenges will only continue to grow: according to a report from the U.S. Energy Information Administration (EIA), global electricity demand is anticipated to climb by about one-third to three-quarters by 2050.

To solve this, we need to build a lot more transmission lines: however, this cannot be the only solution. Transmission lines cost billions of dollars and take 10 years or more to complete. If we are to keep rates within acceptable limits while meeting current load growth, we need to optimize the use of the existing grid using grid-enhancing technologies. →

According to the DOEs Liftoff report, grid-enhancing technologies, such as Dynamic Line Rating (DLR), can reduce congestion costs by 25-50%, providing ratepayers in the U.S. with $5 to 10 billion (USD) in annual cost savings. New technology combining software and sensors can unlock 30-40% of untapped transmission capacity of existing transmission grids. Historically this untapped capacity has not been used, but now, the U.S. government is stepping in to ensure that utilities start utilizing parts of this capacity by mandating Ambient Adjusted Ratings (AAR) on all transmission lines.

However, we need to do more and unlock the full potential through DLR because consumers and the economy can't wait for more capacity–nor do they need to.

Getting more out of existing infrastructure

In order to completely understand the landscape, we need to understand what capacity-unlocking technologies are available to utilities. These technologies generally provide AAR or DLR typically, taking the form of either software or physical sensors. Their goal is to measure the safe levels of electricity that can be transmitted through the power lines.

Safe transmission, however, depends on several factors, which historically have not been measured. Instead, grid operators have mostly operated their grids through seasonal or static line ratings. These rigid estimates typically account for fixed weather, wind and other conditions for a block of time – typically a full quarter or season. In other words, they don't account for actual conditions that affect the capacity, minute-to-minute, day-to-day or even week-to-week. Instead, they ensure safety by relying on a highly conservative common denominator that results in a whole lot of untapped potential for increased transmission.

Needless to say, they also don't account for the variability experienced at different points on a line, such as lines that cover different altitudes, fall in the path of wind farms or span different microclimates. AARs and DLRs differ from these conservative line ratings by taking into account more environmental variables at a much higher frequency.

AARs are often adjusted daily or hourly by assessing ambient temperature, typically assigned from software. DLRs, by comparison, are derived from sensors that collect real-time data about every single factor that affects transmission capacity at multiple points on a given line, including hyper-local weather conditions, air temperature, wind speed, current, voltage, line angle, sag and more.

Both of these more advanced ratings naturally enable a more complete picture of what's happening on and/or around the line, so operators can assess the actual capacity with higher accuracy than before. Unsurprisingly, when their assessments are based on real conditions, rather than estimated ratings that prioritize safety through inaccuracy, they discover that their transmission capacity typically is significantly higher than they realized.

While both DLRs and AARs are vast improvements over static ratings, the differences between the two are stark. DLRs offer a far more holistic and precise view of line conditions than AARs, but upcoming government regulations aren't looking to make DLR the standard yet.

Government regulations and incentives don't reflect the actual potential for increased capacity

Recent regulations have shown governments' willingness to intervene, requiring transmission operators to adopt technologies that enable at least AARs by July 2025. Current efforts, such as the FERC Order (881) in the United States, however, don't require operators to meet their full potential, as they only require them to implement AAR, rather than DLRs.

While FERC regulations are a step in the right direction, there are solutions in the market that bypass the potential gains of AAR by a significant margin.

Members of Congress are already seeing that regulators need to step in more to ensure that grid operators are doing enough to alleviate upcoming demand, calling for "shared savings" incentives. This incentivizes new infrastructure, but again, distracts grid operators from realizing the current potential.

Utilities can fuel the economy and keep costs low with better technology

DLR technology is already readily accessible and can go beyond what regulations like the upcoming FERC Order stipulate, and we should be preparing and encouraging grid operators to adopt them immediately, for the sake of economic growth. There is no time to waste and focusing only on building new power lines or focusing exclusively on AAR technology is not going to get us to where we need to be.

Real-world case studies have shown that DLR sensors can increase transmission capacity in power lines by over 40%, while AAR software is limited to increases in the ballpark of 4-10%. For instance, Minnesota-based Great River Energy recently conducted a pilot program with DLR sensors and saw an average possible increase of more than 40% on the line in question. Different geographical areas with different altitudes, fluctuating temperatures and high winds, can have an even bigger impact on the increase that could be derived.

While installing sensors through a grid may seem like a high initial cost, it would be just a drop in the bucket for grid operators, especially when compared to the costs they would face building completely new lines. There is an even larger opportunity cost of not installing these new technologies and enhancing grid performance when taking into account the economic growth that physically can not happen without it.

Looking ahead

Grid operators are going to be under an increasingly intense microscope as time goes on. The U.S. economy is going to be straining at the seams, potentially only held back by how fast we can transfer more electricity. As economies find new outlets to grow, infrastructure costs will continue to skyrocket, but utilities can't be the ones holding progress back.

We now have the time to prepare for the massive spikes in energy demand that we know are coming, and can't waste the opportunity to grow where we can. Governments are in the unique position to stipulate this essential technology, to encourage widespread adoption. In the meantime, utilities need to explore the entire suite of solutions available to them to make sure they won't be left behind.

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Jørgen Festervoll is the chief executive officer of Heimdall Power and has more than 20 years of experience in the power sector, working with everything from power production and power-intensive industries to the power grid. He also has broad experience in sales from the Swedish software as a service (SaaS) company, Wide Narrow. Before serving in his current role at Heimdall, Festervall worked at the listed investment company Saga Pure, where he gained in-depth knowledge of the industry and capital markets. Festervall holds a Master of Science in business administration (Siviløkonom) from NHH Norwegian School of Economics.

BRIDGING THE GAP BETWEEN OT/IT: A CRITICAL STEP FOR NAVIGATING A PERFECT STORM OF CHALLENGES

CRAIG CAVANAUGH

A powerful convergence of change happening right now in the utility industry that is forcing utilities to re-think how they manage their operations, re-envision how they work with residential, commercial and industrial customers and re-invent their infrastructures. This perfect storm of events is caused by a series of significant challenges that are hitting simultaneously – creating the biggest industry-wide transformation since electric companies first wired the world for light and power more than a century ago.

I will discuss each of these challenges in a moment, but first, I should point out that there is a common thread that runs through any discussion of how to solve these issues – namely the need to build a bridge between two sides of utility operations that have been purposefully kept apart for decades: OT and IT.

The wall between OT and IT

Operational Technology (real-time control and monitoring of grid operations) and Information Technology (business systems and data) have long had a wall between them, with good reason. OT systems were typically built long before the emergence of IT, and utilities wanted to protect OT's reliability from any negative impacts – including those that could come from IT systems. With that reliability goal in mind, organizations tended to keep OT and IT separated as much as possible. →

Utilities are not alone when it comes to this OT/IT gap. This separation between long-established operational technology and faster-evolving IT systems is a common strategy for organizations whose history goes back decades. As an example, telecom companies whose roots go back to the pre-IT era, often still maintain enormous decades-old switching equipment the size of an entire building floor. It serves as the heart of their operations, and they are deeply cautious of reliability risks created at the intersections between legacy switch equipment and IT. Another example is government agencies whose pre-IT card punch-driven systems were kept isolated from IT for decades – long after punch cards were a distant memory in the private sector. To ensure reliability in many industries, OT stayed on its side of the wall, and IT stayed on its side.

But things are very different now. Maintaining that gap between OT and IT may once have been a recipe for reliability, but today it is a liability in the face of the massive changes facing utilities. To solve the multi-faceted challenges that the industry is confronting, utilities must build a bridge between these systems as a foundation for success.

The importance of OT/IT convergence

The challenges facing utilities range from evolving technology to climate change to the graying of its workforce:

- Rapidly accelerating electrification of the economy – The demand for electrical power is growing dramatically due to factors, such as the rising number of EVs on the road, the massive growth of data centers and the electrification of countless other machines and products. At DistribuTECH earlier this year, this acceleration was the topic that dominated conversations across the conference. Utilities have traditionally faced predictable, manageable growth in demand, with peak demand events being the largest challenge. Peak demand challenges remain persistent, largely due to the impact of climate change, and the overall demand for electricity is placing unprecedented strain on power grids. To meet this demand, utilities need to modernize their grids, rely on a broader set of energy sources and build more flexibility into how they manage energy distribution. All of these changes require far tighter integration between OT and IT systems.
- Climate change, severe weather and the need for greater grid control and resilience – As every reader of EE T&D knows, climate change is creating enormous challenges for utilities. The increasing frequency and intensity of wildfires, storms, floods and heat waves are creating operational challenges and public safety concerns. These issues demand infrastructure upgrades to harden assets, ensure resilience and enable flexibility to mitigate risks. The risk of wildfires is one of the primary drivers for this need for greater control and resilience. To prevent wildfires and respond to fast-moving fires, utilities need highly integrated OT and IT systems that support enhanced risk assessment, mitigation and rapid response, as well as facilitate improved communication with communities, governments and third-party stakeholders. The longstanding wall between OT and IT is a major barrier to responding to these challenges.

- The challenges and opportunities of renewables and microgrids – The accelerating deployment of renewable energy assets and DERs to the grid creates the need for bidirectional energy flow that adds engineering and operational complexity for utilities. The emergence of microgrids requires a similar level of sophistication in how they are integrated into grids and managed. The same is true for other technologies, such as energy storage assets. Traditional OT systems were built to be one-way streets from centralized generation out to energy consumers. The complexity of managing a far more complex ecosystem of energy production, energy storage and bi-directional energy flows can only be achieved through successful integrations of OT and IT.
- Increasing regulatory pressures and consumer expectations – Regulatory pressure to achieve aggressive sustainability goals, mitigate the risk of wildfires, support broader adoption of EVs and much more is increasing for utilities. Additionally, the regulating bodies have increased pressure on utilities and energy providers around energy equity and affordability. The federal funds from IIJA grants in the U.S. also come with expectations that place pressure on utilities to increase grid modernization and resilience. Those regulatory pressures are mirrored by the escalating expectations of consumers for greener energy, greater insight into their energy usage, greater control of their power consumption and more transparency about utility operations. Building a bridge between OT and IT removes significant barriers to the steps utilities need to take to respond to these regulatory and consumer pressures.
- Aging and changing workforce – It is no secret that the utility industry faces significant demographic issues with its workforce. The average age of utility workers is much higher than in most industries, with a wave of retirements impacting workers in a number of critical roles, including OT systems. This trend is leading to industry-wide loss of experienced senior talent. At the same time, utilities are struggling to recruit the next generation of utility employees with the skillsets needed for the future of grid operations. Keeping OT and IT siloed creates vulnerabilities for utilities, as retirements accelerate, and the new generation of workers takes the helm.

Eliminating the gap between OT and IT is vital to overcoming each of these challenges, but it is complex. To successfully navigate the challenges created by the OT/IT convergence and intersectionality, utilities need a holistic approach, strategic planning and a collaborative organizational mindset. It involves not only technological integration but also cultural and operational changes to optimize the benefits of a more sustainable and decentralized energy landscape.

In the next article in this series, my colleague Ben Dwinal will share a set of best practices for successful OT/IT convergence by discussing how geospatial technology and location intelligence play a vital role in bridging this gap.

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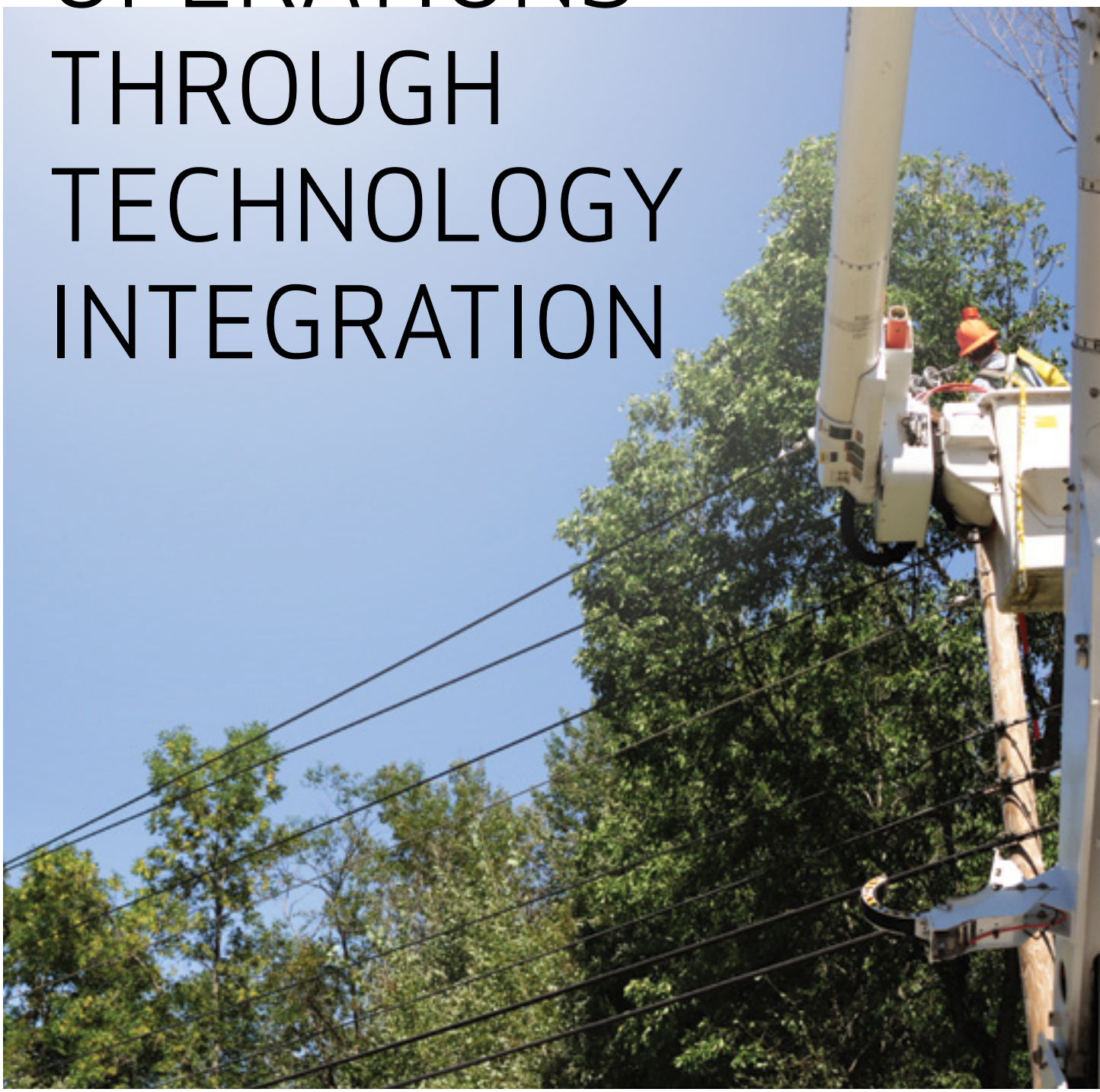
Craig Cavanaugh is the president of TRC's Intelligent Grid Solutions sector. He has been a pioneer in establishing software-focused solutions for the utility industry, covering everything from meter data management to distributed energy resources. A chemical engineer who possesses a Master of Business Administration, Cavanaugh has more than 30 years of professional experience applying advanced technology to complex problems in environmental engineering, telecommunications and utilities.

ENHANCING UTILITY OPERATIONS THROUGH TECHNOLOGY INTEGRATION



Source: Image taken from the white paper called The Potential of the Internet of Things for Utilities published by Panasonic Connect.

CHAD T. HALL

The utility industry is grappling with significant challenges — from workforce shortages to aging infrastructure to cybersecurity threats — that need to be overcome to ensure long-term sustainability and meet the growing demands of customers.

Right now, about 56% of energy workers have 10 or fewer years of service experience, so the industry is focusing on training and upskilling a newer, less-experienced workforce. Aging infrastructure is a further challenge for utilities everywhere, as older systems must be maintained to prevent failures, and companies must invest in their grid infrastructure to enhance resilience and reliability given increases in demand and extreme weather events. Additionally, companies must enhance cybersecurity and awareness of vulnerabilities in the power grids, with the number of susceptible points in electrical networks increasing by about 60 per day, according to the North American Electric Reliability Corporation (NERC).

These challenges, and many others, underscore the urgent need for an integrated approach to digitalization, in which hardware, software and services are deployed in a strategic, holistic manner to position utility companies for both immediate success and future growth. →

Durable, connected and reliable hardware

When it comes to selecting the right kind of hardware for utility workers, there are many features to consider. The devices must be able to withstand the environments that utility workers are subject to daily, including extreme weather conditions and high-pressure situations that demand instant response. The devices must also be equipped with reliable connectivity so utility workers can stay connected no matter where their job takes them, including in rural and secluded areas. Additionally, utility workers need devices capable of handling all their needs, so they don't have to carry multiple devices or adaptors. Long battery life is also essential, as the last thing workers should be worrying about when servicing areas that have been impacted by a disaster or outage is finding an outlet to charge their device.

Rugged mobile solutions are an ideal solution for many utility workers. Built with remote workers in mind — in fields ranging from the public sector to field service to the military — rugged computing devices help utility workers optimize operations, streamline workflows and increase productivity. The devices are built to withstand harsh conditions, including freezing temperatures, extreme heat, drops, spills, dust and dirt. This durability ensures that workers don't have to worry about their devices breaking or causing delays. For example, a lineworker working to restore powerlines after a winter storm can use their rugged device to pinpoint where outages are occurring without concern for the device failing in low temperatures, allowing them to focus on quickly and effectively restoring power to the community.

The latest rugged mobile devices offer multiple connectivity options, including 4G, 5G and other industry-specific Private LTE networks, so field personnel are always able to communicate effectively, access real-time data and location information and receive critical updates regardless of their location. This enhances their ability to respond swiftly to issues and maintain continuous operations, no matter where they are. For example, a utility worker might need reliable connectivity when detecting and repairing an underground water pipe leak in a rural area, so they can accurately identify the location and severity of the leak using real-time Geographic Information System (GIS) or other data. Reliable connectivity allows them to swiftly identify the leak, minimize excavation and execute precise repairs, ultimately reducing service disruptions and preventing further infrastructure damage.

Modular rugged devices can meet workers' many needs with a single device, with accessories like barcode scanners, extra batteries and additional ports added as needed. That flexibility is critical for utility workers, who often need to connect to legacy hardware using cabled serial ports, external metering devices and specialized diagnostic equipment to interface effectively with and maintain older systems. Workers also may need hot-swappable batteries to support their long shifts in the field, as they may not have the luxury of charging their devices in an office setting.

A technician troubleshooting issues with a transformer might need to connect to diagnostic tools and equipment through serial ports, while also using a barcode scanner to track parts and relying on an integrated GNSS system for navigation and precise location positioning for the asset. A single rugged device can support all these needs and more, so workers can reduce downtime, increase productivity and ensure efficient, uninterrupted service in challenging environments.

Software integration for enhanced utility operations

Utility companies must ensure that the hardware they choose to use is compatible with their preferred software applications. Integrated software improves data collection, diagnostics, security and overall operational efficiencies, and when fully compatible with the hardware, it gives workers an intuitive user experience and allows them to interact with legacy systems. Hardware and software companies need to work together to ensure that their devices provide reliable performance, support essential applications and integrate easily into daily operations.

In the example shared earlier in which a utility worker is tasked with locating and repairing underground water pipe leaks in a rural area, leak detection software integrated with GIS data on a rugged device with multiple connectivity options provides a compelling solution. The hardware and software can be used to accurately identify the leak's location while reducing the amount of digging required and minimizing disruption. By pinpointing the precise spot of the leak using user-friendly software, the utility worker can expedite repairs, restore service faster and avoid unnecessary excavation.

Source: Panasonic Connect

Cybersecurity is another challenge that can be addressed with integrated hardware and software solutions. Utility companies must monitor, identify and respond immediately to security threats on the power grid using cybersecurity software that's integrated with real-time threat detection and response systems. The latest software can analyze network traffic, detect anomalies and alert utility companies to suspicious activities, so companies can take swift action to secure critical infrastructure. Using these advanced security tools, workers can prevent breaches, ensure the integrity of the grid and continue to deliver uninterrupted service to customers.

Comprehensive service and support

The job does not end after selecting the right device and ensuring that it is compatible with the necessary software — from unboxing to registration and imaging to configuring multiple settings, the steps following purchase can be the most time-consuming. That's why, in addition to hardware and software, utility companies must seek out technology partners that offer services and support throughout the deployment process and device lifecycle.

As the last piece of the puzzle, services and support provide the extra help that many short-staffed utility companies (including small or mid-sized utilities that may be limited in IT staff) need to ensure their hardware and software are correctly set up, deployed and maintained. Professional services and support can maximize uptime and accelerate return on investment, as well as enhance operational efficiency, reduce costs and help utility companies deliver reliable service to their customers.

Services and support can also alleviate some of the pressure that falls on IT teams. For instance, technology partners can provide proactive device monitoring and remote diagnostics for early detection of cyber threats, minimizing potential disruptions and optimizing device performance. Additional services may include support for routine tasks, such as device monitoring and repairs, so full-time teams can focus more on strategic business initiatives.

By partnering with a technology company that provides anytime and as-needed IT staffing solutions, companies gain an extension to their IT staff through their technology partner, relieving in-house specialists. →

Source: Image taken from the white paper called The Potential of the Internet of Things for Utilities published by Panasonic Connect.

An ecosystem for success

With the right synergy of hardware, software and services, utility companies can achieve operational excellence, enhance reliability and ensure resilience in a dynamic environment. By deploying robust hardware solutions designed to withstand harsh conditions, integrating sophisticated software and taking advantage of comprehensive service and support, utility companies can streamline workflows and bolster efficiency, ultimately helping them overcome the challenges facing the industry today.

Looking ahead, the prevalence of AI and AI-enabled computing will continue to transform utility operations and help achieve future success in the industry. With 74% of energy and utility companies implementing or exploring using AI in their operations, utility companies need to take full advantage and equip their workforce with AI-enabled devices that are designed to accelerate data-driven tasks like optimizing grid management, improving predictive maintenance and finding operational efficiencies. While out in the field, utility workers can leverage these tools to analyze large datasets from meters to predict failures before they occur, with incredible speed. But, to do so, the device must be both rugged to work in harsh environments and powerful to process large amounts of information in near real-time. To fully harness AI's transformative potential, utility companies need to invest in an integrated ecosystem of AI-compatible hardware, advanced software and comprehensive services designed for enhanced collaboration and operational excellence.

While hardware, software and services are all important on their own, it is the combination of all three that enables utility companies to deliver exceptional service to their customers. This holistic approach — aided by an experienced and future-looking technology partner — positions utility companies to meet evolving customer demands with agility and confidence and optimize operations for long-term success.

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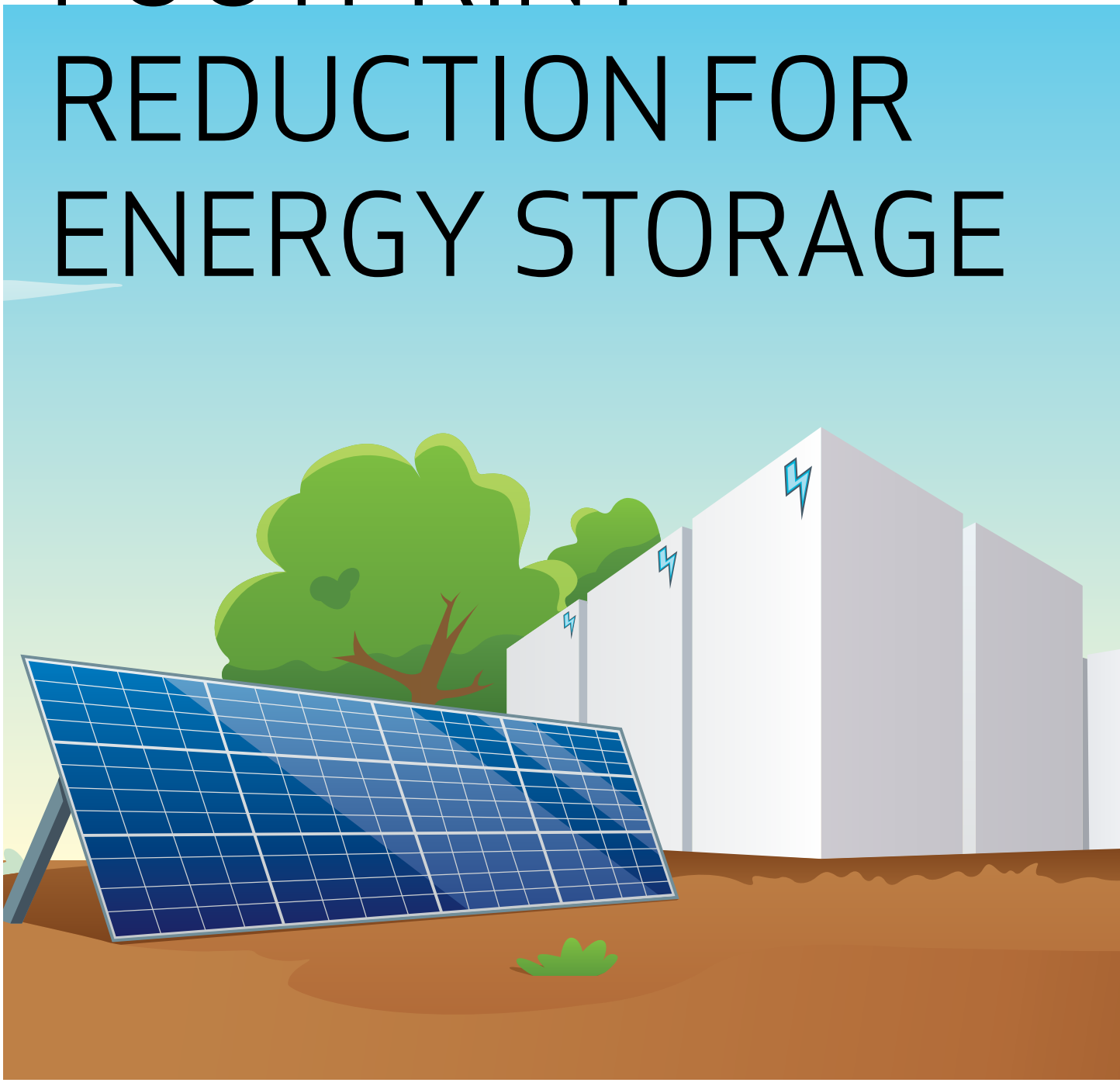
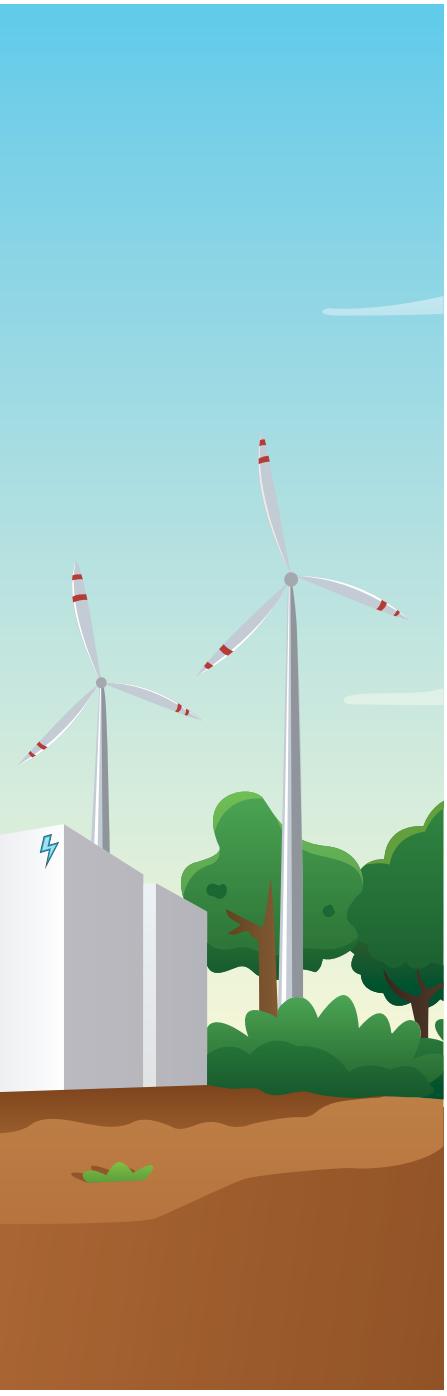
Chad T. Hall serves as executive business development manager at Panasonic Connect, overseeing the development of rugged mobile solutions to support the utility sector. He obtained his bachelor's degree in geography and master's degree in geographic information science and cartography from Texas State University.

TRENDS IN FOOTPRINT REDUCTION FOR ENERGY STORAGE





DAVE DONG

To build a low-carbon future, the world needs to reduce its dependence on fossil fuels and transition to renewable energy. Energy storage is a critical technology to that process. Because renewable sources cannot produce power on demand in the same way that legacy power generation technologies can, energy must be reliably stored to bridge the gap between when it is generated and when people need it. Solar energy presents a particularly clear challenge: solar power is produced during the day when it is sunny out, and people need to use more power in the evening when it is dark out.

Bridging the gap

Battery energy storage systems help bridge that gap by storing energy in batteries for use at a prescribed rate and time. This decouples time of generation from the time of use and allows energy to be delivered when consumers need it. As battery energy storage technology continues to evolve and improve, it can provide increasingly improved utilization of renewable resources while at the same time improving grid reliability and price stability for consumers.

Battery energy storage use extends beyond grid power. It is also used in commercial and industrial applications to enhance reliability of energy availability and reduce costs by using stored power during times when grid power is particularly expensive. Residential homes or small communities can also improve energy independence and environmental sustainability by connecting energy storage systems to distributed energy resources like rooftop solar. →

Increased adoption, reduced footprint

However, to meet the increasing need for energy storage, these systems need to get smaller. The International Renewable Energy Agency estimates that 90% of the world's electricity may come from renewables by 2050. This will require a dramatic increase in renewable power generation. Achieving this will require both innovations that make renewable energy generation more efficient while taking up less space and a dramatic increase in the space we put towards renewable installations. Power generation companies need to prioritize using the space they have available to generate renewable electricity. Every square foot spent storing energy instead of generating it presents missed opportunity. For this reason, energy storage installations must be made as small as possible while storing as much energy as possible.

Footprint reduction is also important for EV charging stations and commercial and residential buildings that have limited physical space for energy storage. As EVs become more widely adopted, the EV charging infrastructure buildout has become a major infrastructure initiative. Charging stations need to limit their footprint to meet demand, especially where they are being installed alongside existing gas pumps without increasing their real estate footprint. Smaller battery energy storage systems help enable this. Similarly, commercial and residential applications may not be able to change the layouts of buildings to accommodate energy storage systems and therefore need to find ways to fit them into existing architecture.

Reducing energy storage footprint

Battery technology is improving, and batteries themselves are getting smaller. However, battery energy storage installations still need the right supporting infrastructure to connect, protect and cool batteries close to one another. To reduce overall the footprint of a battery energy storage installation, it is important to look for efficiencies in how batteries are connected to one another and the system as a whole, as well as to examine the cooling method of the entire system.

Liquid cooling is being deployed in data centers around the world to manage the increasing heat density of next-generation AI and ML installations. Liquid cooling is more efficient than air cooling because liquid has a higher heat transfer capacity than air does and can get closer to the source of heat. Similarly, liquid cooling can be used in energy storage applications to manage the heat loads generated from rising power density. Liquid cooling works in energy storage applications by using a chiller to pump cooled fluid through the system in a closed loop, with precision control adjusting fluid temperature and flow rates to maximize efficiency. By raising the cooling capacity of energy storage systems with liquid cooling, battery module manufacturers can fit more batteries closer together and increase the power capacity of their installations without increasing their footprint.

However, even with batteries appropriately cooled, they need to be connected to one another, and to whatever applications they are powering. Traditional cable solutions, while appropriate in some applications, can be difficult to use when footprint reduction is a primary concern because they often do not have a safe bending radius high enough to accommodate tight turns in small spaces. In these instances, flexible conductors, such as flexible busbars or braids, can offer more design options due to their reduced cross-section and minimal bend radius requirements. These busbars can be prefabricated to save time and labor on job sites.

What's next?

As demand for energy storage continues to grow and government investments in infrastructure increase around the world, reducing the energy storage system footprint will be an important challenge for energy storage manufacturers. Microgrids, EVs and utility-scale renewable energy will all require energy storage solutions that can scale with them to serve power companies, commercial buildings and more. Getting ahead on designs and technology for reducing energy storage footprint will help energy storage companies get ahead of their competition, and reexamining these systems' power connections and cooling technologies is a great place to start.

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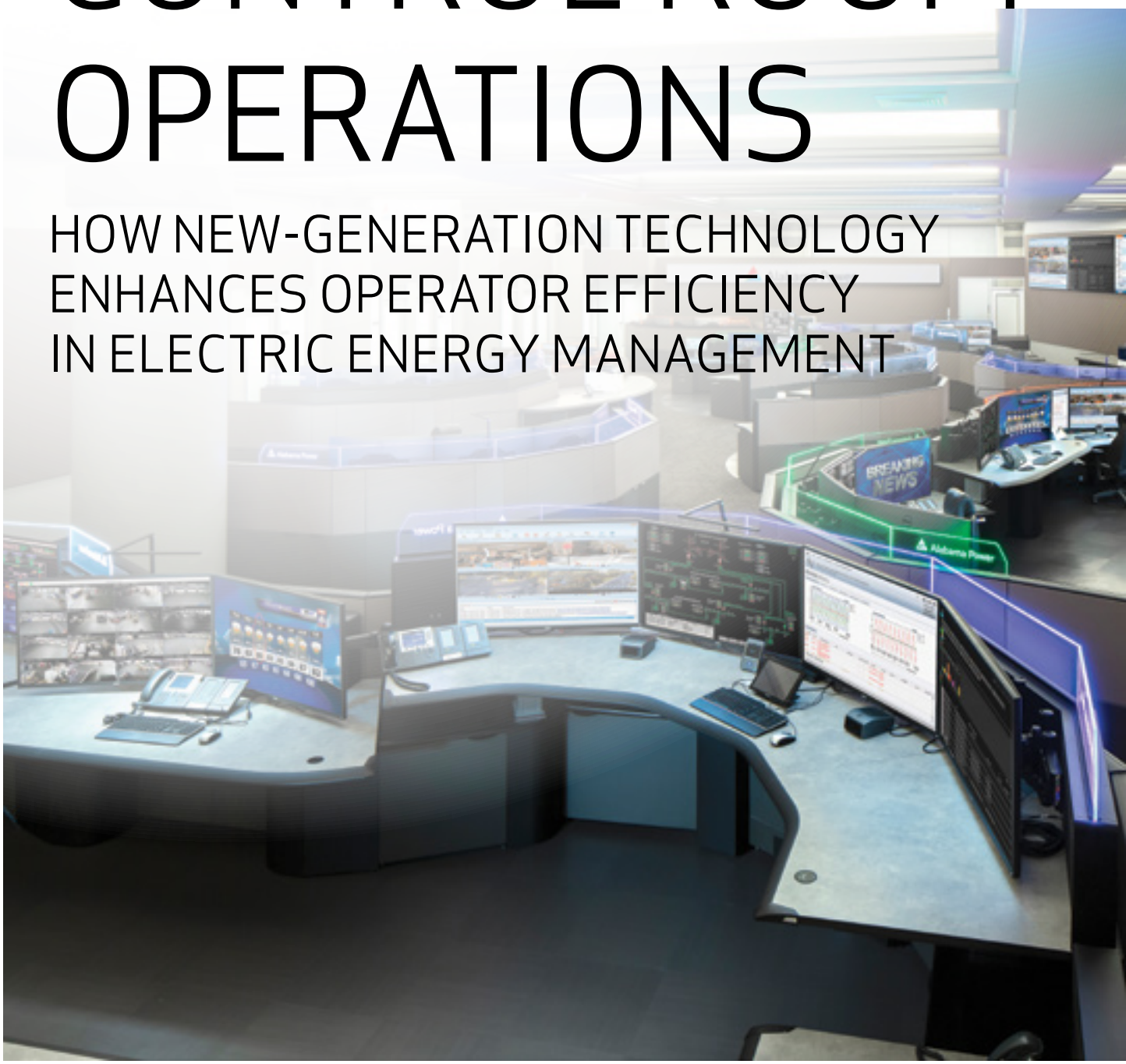
Dave Dong is the director of Vertical Growth for North America at nVent. With a decade of experience at nVent, Dong has been instrumental in steering the company's Power and Grounding Solutions division. Holding an electrical engineering degree, Dong's expertise lies in the dynamic fields of energy storage and e-mobility.

OPTIMIZING CONTROL ROOM OPERATIONS

HOW NEW-GENERATION TECHNOLOGY ENHANCES OPERATOR EFFICIENCY IN ELECTRIC ENERGY MANAGEMENT



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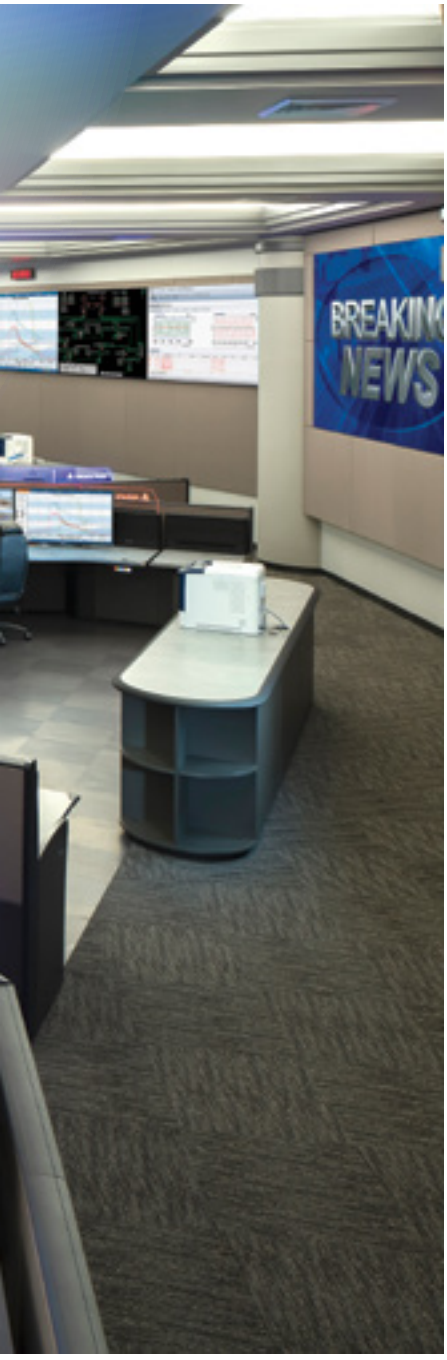

TYLER BONNER

Technology is only as good as the experience it provides to people who use it, and it's critical to deliver the right experiences to the hard-working operators in energy utilities' control rooms.

These people regularly work 10- to 12-hour shifts. If they are helping with a power restoration effort after an ice storm, for example, these operators may need to work several shifts in a row.

Their work is mission-critical. Without power, our hospitals and homes don't work very well. So, it's crucial that operators have the right technology to allow them to take care of our families.

Yet control rooms are frequently designed as if they are general office spaces for average office employees rather than for operators who work at organizations that are under heavy scrutiny by government agencies and who spend sustained, long-cycle shifts on mission-critical work.

That can stand in the way of optimal efficiency and compliance, create operator fatigue – potentially leading to errors and adversely impact utility efforts to attract and retain top talent. →

Source: Diversified

The operator experience is more complex and stressful than ever

Making control rooms extremely effective for the people who work in these spaces has never been more critical because the operator experience is more complex and stressful than ever.

Operators already do crisis management. Now they must also work with and understand an overwhelming number of applications. And the utilities that operators work for can incur hefty fines if they don't comply with North American Electric Reliability Corporation (NERC) critical infrastructure protection (CIP) standards, which adds pressure to this already high-pressure job.

People want to contribute. But clutter, suboptimal lighting and video, excessive noise and a flood of applications and data are distracting and make it harder for operators to be successful.

The new generation of operators expects next-generation technology

Thirty percent of the energy workforce is under 30 years old, while the national average is 22%, according to the U.S. Department of Energy's 2023 U.S. Energy and Employment Report. Only 17% of the energy workforce is older than 55, much lower than the 24% national average.

Outdated technology and poor experiences are especially problematic for the new generation of operators, who were raised on mobile devices that put convenience at their fingertips. So, utilities now have to make their control rooms attractive to the next generation of talent. If a new operator sees a mosaic tile board in a control room, it can be a big turnoff. The operator might think that they could work anywhere else and see more advanced technology than this.

Next-generation technology provides better experiences. It can also serve as a recruitment tool.

Outdated technology and poor experiences can lead to operator turnover

New data from Barco indicates that the less productive operators feel, the more likely they are to switch jobs. For people who rate their productivity as poor, the likeliness that they will soon switch jobs rises to a staggering 81%. If the operator experience is poor, that probably means the control experience is poor. That can create problems both in hiring and keeping operators.

Operator churn is extremely problematic because it can take a year for these individuals to get enough training and experience to become really productive. The training process for operators, as PSE&G principal engineer Ahmed Mousa explains, "is comprehensive and covers hundreds of specifications/procedures that are vital to the operation. ECCOs are like the supercomputer located in the U.S. Patent Office, where during emergencies, we are expected to dig deep in our brains and recall from our memories certain specifications and directions."

Plus, control room operators are well-compensated employees. Why stop short of investing in the environments in which they work? Make it a great experience so they don't want to leave.

For optimal experiences and outcomes, take a people-first approach to design

So, how can utilities and their partners make control rooms extremely effective for operators?

Approach the control room like a space shuttle mission – build everything around the astronaut.

One approach to make that happen is to start by talking with operators to understand their real challenges.

Ensure that all the information operators need to do their jobs effectively is easily available to them. Make things simple and easy to use. Think about how sound and lighting impact their experience and what you can do to improve on those fronts. Embrace systems and technology that are flexible so they can easily adapt over time as new applications and methodologies arise.

Turn down the volume on distracting, unnecessary noise

One of the top complaints in control rooms is that these environments are too loud.

When movements or repetitive dinging from HVAC units, for example, create a lot of noise, it can be very distracting to operators. It can also make it hard to understand communications coming from outside the control room. In a mission-critical environment like a control room, those communications can be key to enabling operators to understand the mission and how they will serve to restore power and save lives. So, getting overall room acoustics right is vital.

Work with partners that have deep experience in design environments with quality sound.

Reduce fatigue by adjusting lighting, ensuring video is color balanced

Like astronauts, control room operators work in 24/7 operations. Typically, operators rotate shifts, working during the day and then, over time, taking the night shift. That can be a tough transition, making it challenging for control room operators to stay awake and alert.

Changing the color of lighting helps operators adjust from day shifts to night shifts by affecting circadian rhythms and impacting the production and release of melatonin, which plays a role in sleep. Lighting adjustments can also help increase operator alertness throughout their shifts.

Lighting is also a vital consideration in designing video walls within control rooms. Desktop displays are typically brighter than video walls. If operators' eyes constantly have to change aperture as they move from desktop displays to video walls, it can lead to repetitive eye strain, migraines and, potentially, time away from work. Partners with deep experience in IT for mission-critical environments can help utilities understand and avoid such problems by ensuring the light coming off of video walls is commensurate with the lighting at operators' desktops.

Color balancing is also critical. You may have noticed LCD arrays at airports or retail malls that look like a patchwork quilt of colors. That's because those displays haven't been color balanced. When video walls in the control room aren't color balanced, it can lead to operator eye fatigue. Some video walls will color balance automatically. But you can't just take any monitor that you might put in a conference room and expect it to be a strong performer inside a control room. You need to select and configure technology to make it sustainable for control room use.

Eliminate distracting desktop clutter and increase operator visibility

Dominion Energy South Carolina was recently working to optimize its control room to accommodate more operators to manage the company's growing number of solar generators. In the process, it learned of new technology that it thought would add value, so it decided to do a full control room upgrade. One goal was to reduce the clutter that its operators were facing.

People tend to be more comfortable sitting at their desks after they clean off their desks, and clutter-free desks can help to prevent operator error. Imagine an operator had six or 10 keyboards on their desk and something was happening on the grid that they needed to respond to. Lee Xanthakos, director of electric transmission planning and operations at Dominion Energy South Carolina, explained that when operators repeatedly have to figure out what keyboard and computer they need in any given situation, it creates mental fatigue over time. →

Source: Diversified

One global technology solutions provider based in Kenilwort, N.J. worked closely with Dominion to reduce the number of monitors on operator desks by replacing eight to 10 20-inch desktop monitors with four much larger monitors. The provider also reduced the clutter on operator desks by decreasing the number of keyboards and computer mice to a manageable level. Reducing distracting clutter has resulted in better operator experiences.

Providing better, clearer visuals also helps operators to do their jobs as well as possible. So, Dominion also elected to replace its existing wall monitor with a 4K wall. The high-level definition makes the grid map on the wall monitor clearer for Dominion's operators to see.

"We have around 3,300 miles of transmission line, over 400 substations, dozens of generators," Xanthakos said. "The tools that [the N.J.-based solutions provider] has provided allow us to have all of that up at one time and see the status of all of it. We can see what lines are in service, what lines are out of service, what generators are producing power and which ones are not. By having that large visual, we can spot developing problems and resolve them before there actually is an outage."

Remove operator guesswork by using data to tell the story

Control rooms are typically built to run for seven to 12 years. Over that period, a lot of applications come into these environments. Perhaps new leadership comes in with different ideas on which applications are needed to monitor the organization's systems. Then the next regime comes in or a new form of power and facility enters the equation and changes things.

Constantly changing applications means that operators have to continually learn new applications. Rather than putting all the onus on operators, utilities can leverage assistive intelligence. Running software that analyzes, correlates and learns from data from disparate applications can help operators understand and act on situations faster and more intelligently.

With seamless integration, you can also trigger red lights on the desktop or in the room, or audible alerts, so that operators know there is a problem. Seamless integration in control room design can also display on the video wall information that's germane to that particular situation.

Use secure visualization to operate on a need-to-know basis

Not everybody needs access to all of an organization's data all the time to get the job done. With secure visualization, electric utilities can write roles and permissions into their visual platforms so that operators see precisely what they need to do their jobs and nothing more.

Roles and permissions also enable utilities to securely push out visual information to a website so field technicians can see what's happening from the control room perspective. Plus, roles and permissions prevent information from being shared with those who shouldn't have access to it.

Patching updates, publishing vulnerabilities and roles and permissions are also all extremely important for organizations that exist in environments that are governed by NERC CIP.

Select a proven partner to allow for continuous improvement

AV-based solutions that are very rigid in their design and can't change as control room applications and operator requirements change over time just don't work in today's world.

Mission-critical operations today need control rooms that are designed to be flexible and secure and that remove obstacles and deliver optimal experiences for their hard-working operators.

To ensure your control room works best for you and your operators, seek technology partners with deep experience designing mission-critical environments, take the time to fully understand your needs, help you identify the right solutions for your unique requirements, ensure your environment is secure and the technology you're using is NERC CIP compliant and is committed to supporting you and continually improving your experience.

ABOUT THE AUTHOR:

Tyler Bonner is a dedicated executive with more than 20 years of leadership experience, specializing in mission-critical environments. Bonner has been instrumental in building Diversified's control room business. His passion lies in enhancing the effectiveness of mission-critical operations, which ensure the safety, stability, and efficient functioning of essential services that communities rely on daily. Bonner excels in working with clients to ensure their control rooms meet the highest standards of efficiency and reliability. His deep expertise and commitment to excellence have made him a key figure in driving Diversified's success in this crucial sector.

BOBBI HARRIS, UTILITY BROADBAND ALLIANCE

ELISABETH MONAGHAN

For about five years, Bobbi Harris has been the executive director of the Utility Broadband Alliance (UBBA). If you're unfamiliar with UBBA, the organization strives to empower utilities and eco-system partners in the development of private broadband networks as a key enabler of the utility of the future.

For our Q3 issue's Powherful Forces profile, we asked Harris to talk about her career trajectory, her role at UBBA and UBBA's role in the utility sector.

How I landed in the utility sector

I began my career in high-tech, data analytics and software marketing more than 25 years ago and never once imagined that experience would ultimately lead me to the utility sector. At that time, utilities just mailed a bill once a month and didn't seem very high-tech to the general public.

Thankfully, as the industry embraced increasing digitalization, my career moves (whether planned or not) led me to work on software and analytics tools built for utility use. These solutions, such as SCADA software, Advanced Metering Infrastructure (AMI) tools and Distribution Automation solutions, all had elements of utility tele-communications infrastructure and networks, so I learned a lot about the evolution of utility technology. I was hooked!

Water, gas and electric utilities all had one thing in common: they needed to change to meet the more demanding needs of the customers they served. Utilities needed to learn how to communicate internally to share operational data to gain efficiencies — and externally with customers, in order to show they were more than just a "ratepayer." This is where my communications skills and passion for protecting our resources finally melded into a career, and I never want to leave the utility industry.

Influences and role models

My story isn't all that different from a multitude of other women who have had to overcome challenges in what was a male-dominated industry. The biggest challenge I faced was being taken seriously in the utility space, not only as a woman but also as a non-engineer. I had to learn everything I could about the technology so that I could intelligently speak with engineers. Thankfully, those early days in software marketing helped me translate "engineering speak" into common terms and translate the bits and bytes into value-added stories. I proved to the people I worked with that I brought value and intelligence equal to but different from their own. Today, I see the utility industry evolving, especially with more women in leadership roles.

When I started my career in this industry more than 25 years ago, we didn't really have "mentors" so much as we had people we could trust and talk with. That being said, I did have several women I looked up to and would talk with and learn all I could from their careers. Becky Blalock (former SVP & CIO of Southern Company), author of the book "DARE," was one of the first women leaders in the utility industry that really spoke to me, literally and figuratively. Her book is still one of my go-to books when I need a reminder of what I can do in this industry and beyond.

There are other women who have been role models to me, like the late CEO of UTC, Connie Durcsak, whose vision and passion for the utility telecommunications industry profoundly imprinted on my life and career. Others, like Tami Barron of Georgia Power, Jill Anderson of Southern California Edison, Kim Kerr from UScellular for Business and Jennie Bratten from Ericsson have encouraged and inspired me every day to continue in the industry I love so much. I hope I can be a role model to other women who need to know that whatever their education or career path has been, the utility industry needs passionate and compassionate leaders to take the sector into the future. After all, this business is personal to everyone on the planet.

UBBA's role in the industry

As the executive director of UBBA, I work with utilities and solution providers across the country to advance education around the deployment of private broadband networks in critical infrastructure industries, including electric utilities. The whole concept for UBBA began about five years ago with just a few key members in a single room, and I'm amazed at how quickly we've grown. We incorporated in 2021 and currently count more than 35 utilities in our membership of more than 100 organizations!

At UBBA, we believe private broadband is a critical enabler of utilities' journeys toward a more secure, resilient and future-proof grid. From connecting advanced metering infrastructure to coordinating distributed energy resources (DERs) to accelerating outage restoration efforts, high-speed communication is essential to meeting the challenges utilities face in 2024 and preparing them for what's to come. Through our continuing industry education, we're providing the resources and opportunities for utilities to learn more and share best practices around deploying private broadband networks, as well as collaboration opportunities that enable them to learn from their peers who are at different stages of this journey. →

What we're working on

We recently filed public comments in support of the Petition for Rulemaking requesting that the Federal Communications Commission (FCC) provide an option allowing for the deployment of 5/5 megahertz broadband networks in the 900 MHz band. Previously, the FCC determined to realign the 900 MHz band and establish a 3/3 MHz broadband segment, a landmark step creating a significant opportunity for utilities to design, deploy, and operate private broadband networks. We believe that providing an option for 5/5 MHz broadband operations in the 900 MHz band will promote the continued evolution of a broadband ecosystem to support services critical to the public and the economy.

Another initiative we're tremendously excited about is our annual UBBA Summit & Plugfest, which we'll be hosting in November in Kansas City. Last year we achieved record attendance of more than 500 utility and telecommunications technology leaders, and we expect to exceed that total in 2024. It's a great opportunity for utilities to learn from their peers and discuss a wide range of issues related to the deployment of private broadband networks.

Emerging trends

Everyone is talking about artificial intelligence (AI), and for good reason. The potential use cases for AI in the utility industry are incredibly exciting to our members, who are working to better understand these use cases and educate the industry on the role private broadband communication plays in helping enable them. At the same time, the impact of AI on the grid is significant, as the energy needs of AI – and in particular, AI data centers – far outweigh the infrastructure that is currently available. As demand for AI grows, we anticipate increasing strain on the grid, as has been widely reported, again reinforcing the need for additional grid modernization.

Challenges ahead

It's no secret that the grid needs significant upgrades to support the rapidly advancing innovations that are shaping our industry, such as electric vehicles. As these technologies proliferate, many have raised concerns about the ability of the grid to support evolving energy needs. Modernizing and improving grid resiliency is the top priority of many utilities, and high-speed communication is a critical building block in their road to grid modernization.

Another challenge is the ever-present need for more stringent cybersecurity. Whether it's ransomware, data breaches or Denial-of-Service (DoS) attacks, threat actors view the grid as a particularly vulnerable target, and it's critical that utilities do everything they can to protect themselves and their customers. One of the key benefits of private broadband is that it's private – only the utility has access to the infrastructure supporting the network, so cybersecurity is baked into the value proposition. This is a key element of our industry education and a priority for many of our members.

Why I love what I do

The phrase "servant leadership" speaks to my core values. I love that my work affords me so many opportunities to champion others while leading organizations in the most essential of industries. My own values and work ethic mimic the utility industry's core values of providing safe, secure, reliable electric, water and gas services for the communities they serve. Day or night, storm or blue sky, utilities are there to deliver. This is what I love about my work: many times in the background and sometimes on stage, I deliver the things most people take for granted.

ABOUT BOBBI HARRIS:

Bobbi Harris is a utility telecommunications and smart city industry expert, the founder of Smart Water, Smart City, LLC and the executive director of UBBA. She is a leader in market analysis, strategic intelligence and marketing strategy. In her years as a global strategic marketing professional, she has focused on utility issues, business drivers and telecom technologies to address water and energy challenges including smart cities, cleantech and green building initiatives. Her insights are sought by key stakeholders, including elected officials, investors, electric, water and gas utility leaders and technology executives worldwide. Harris is one of the ESI 2019 Global Smart Energy Elites. She graduated summa cum laude from Campbell University and earned her MBA from the same.

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