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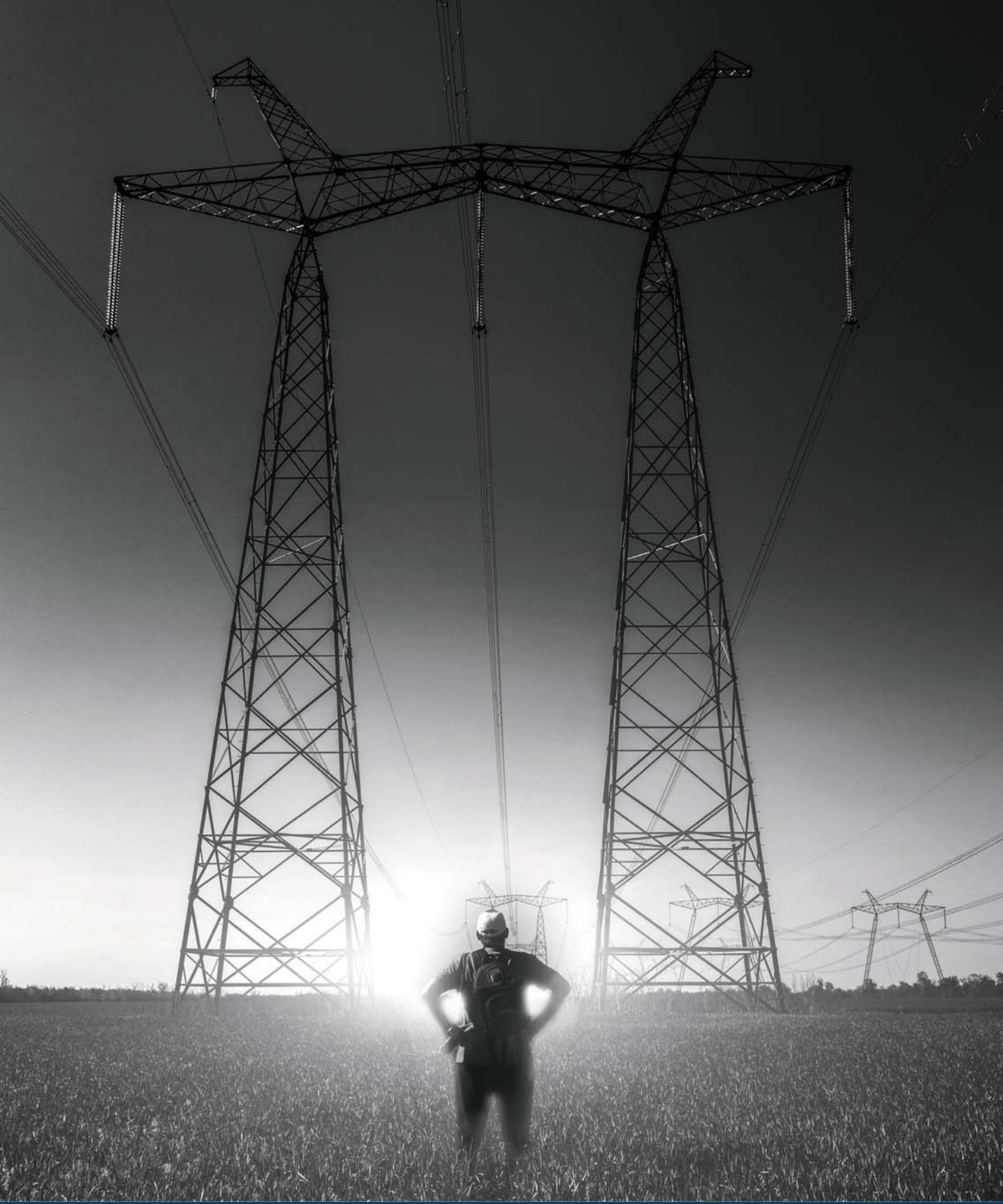

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GenAI: A Utility Disrupter and Enabler

In early November, I attended UA Week, an event created by Utility Analytics Institute, a sister brand to *T&D World* within Endeavor Business Media's energy group. One of the event's focal points was generative artificial intelligence (GenAI). Prior to this event, I'd mostly heard that GenAI creates a lot of risks and dangers, but the message at UA Week was different.

The most in-depth GenAI discussion I encountered during the week featured a panel of four data science experts, three representing large investor-owned utilities, and one representing a software consulting company. Given that utilities are often considered conservative and slow to change, I was surprised to learn that these three utilities are embracing GenAI.

Andy Quick of Entergy, Andy Kapp of Evergy, Valli Mithukaruppan of Exelon, along with David Bess from technology company Neudesic, were eager to share their views on GenAI. Evergy's Andy Kapp stated that GenAI will have an impact on society comparable to the introduction and adoption of computers. He also believes it will fundamentally change the way work is done and cautioned that companies, including utilities, risk losing their talent if they don't embrace it.

David Bess agreed with Kapp's computer analogy and added that GenAI will improve and advance by "magnitudes" every year for years to come. He believes the technology will be adopted at home before it enters the workplace, like apps were adopted when they first became available. Bess stressed that utility employees must be trained to use GenAI and that it must be effectively managed.

Valli Mithukaruppan of Exelon echoed many of Kapp and Bess's sentiments, emphasizing that utilities must learn to scale the technology and stay ahead of the curve as the adoption is progressing rapidly.

Andy Quick mentioned that Entergy is actively working on a comprehensive GenAI strategy. He anticipates that much of the innovation supported by GenAI will come from the employee level. Quick said that Entergy plans to educate and train employees on the technology and its potential, followed by a rollout of the technology. He predicts that "enterprise GenAI" will transform the way work occurs within the utility, shifting some tasks from human workers to "digital workers." Entergy's data science group is currently developing a new AI governance plan and organization, which will soon be proposed to Entergy's board.

Kapp shared a similar message, describing GenAI as employees' new co-worker. Evergy hasn't released a formal training program for employees yet, but Kapp and his fellow data analytics and science experts have begun offering "lunch and learns" on the topic.

"In March and April, we were really bullish to get GenAI rolled out, but I pumped the brakes on that a little," he said. That doesn't mean, however, that Evergy is not using any GenAI technology. Kapp's group is using GenAI tool Copilot and has also layered Chat GPT on top of some current tools, which employees are testing for accuracy and other features. Kapp pointed out that Chat GPT has been used for tasks traditionally performed by company employees, freeing up their time for more complex assignments.

In general, the four experts expressed more positive views than negative ones about GenAI. However, they all agreed that the technology raises valid concerns. Some UA Week audience members voiced apprehensions about data privacy and security. Bess, who works with many utilities, acknowledged the importance of this concern but suggested that utilities leverage their existing data privacy and security practices rather than reinventing the wheel. He also highlighted another concern, which is that GenAI is likely to render entry-level and junior coders obsolete. Bess said some universities are already seeing students leave programs focused on coding and programming, potentially leading to a shortage of senior-level coders in the future. Kapp spoke about his concerns with some of Evergy's solution providers adding GenAI or similar AI components to the products and services they provide without consulting with Evergy's staff. He emphasized that it's important for vendors to engage with the utility before making changes to their systems.

The four individuals participating in this panel discussion believe that GenAI should be embraced. However, results of an audience survey conducted during the panel session reveal they might be outliers. The survey showed that 45% of the companies represented in the audience don't have a GenAI strategy, and 72% have no unique governance structures for AI. For the 55% of companies that are working on some type of GenAI strategy, nearly half (44%) said their companies' internal data analytics team is driving that initiative. One additional polling question asked audience members whose companies are using GenAI, what common use cases are being piloted. The top answer was coding, followed by supply chain and rate cases.

While the four panelists were enthusiastic about the positive impacts of GenAI, they acknowledged that well-trained and knowledgeable individuals are essential to realize its benefits. They also cautioned that GenAI must be thoroughly understood and effectively managed to ensure it doesn't produce unintended consequences. Bess encouraged the audience to empower themselves to learn about GenAI and reminded them that it is not the first technology disrupter. Mithukaruppan recommended creating a long-range plan to guide the adoption of GenAI. Likewise, Quick also emphasized the importance of creating a GenAI strategy, stressing it should be created intentionally rather than letting it evolve organically. Kapp stressed that GenAI is a co-pilot, not a pilot, and will not replace humans in the workplace. He also told the audience to adopt, adopt, adopt…don't resist. TDW

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Who's Making the Grade (And Who's not)?: **Think Microgrid's 2023 State Scorecard**

Installations of microgrids are happening with such accelerating frequency and capacity that many think it's going to be a gold-paved, toll-free highway to success for independent, on-site power.

Reality check: The path to deployment is confronted by numerous policy barriers in most states of the U.S., according to a new research report by industry advocacy group Think Microgrid. Its "State Scorecard 2023" delivers barely passing grades to most states, with only a few gaining higher marks, if not full honors.

Across the nation, as studied by Think Microgrid's policy team, only Connecticut, Colorado, Hawaii and Texas merited Bs in the State Policy Scorecard. Most were handed Cs or Ds. In many of those states with average or worse grades, outdated utility policies and regulations impeded the otherwise exponential growth of microgrids nationwide, according to the report.

"There is no doubt that microgrids can be the foundation of a grid that is truly resilient, clean and equitable," Cameron Brooks, Think Microgrid's executive director, said. "But that outcome is hardly inevitable — it requires deliberate and thoughtful action."

Dramatic Expansion

Indeed, the expected electrification of the American economy, coupled with a utility grid that is clearly not yet ready for vast growth in both facility load and electric vehicles, is pushing the call for a dramatic expansion in microgrids and DERs. The added value chain in utilizing aggregated DERs for virtual power plants and other grid services also would seem to make microgrid deployment almost a no-brainer.

And then there's the C&I energy transition — the desire of many companies to both shore up their own energy supply while also meeting sustainability goals. Microgrids provide an on-site solution to meet those twin objectives.

"We have many customers who want state-of-the-art digitized microgrids to meet their desired outcomes of resiliency or decarbonization," said Jana Gerber, president of the North America Microgrid unit at global technology firm Schneider Electric. "The scorecard is an important tool to keep customers and microgrid developers informed of how and where progress is being made."

Public funding, above all else, is driving investment in microgrid projects, as the report notes. For instance, federal funding for microgrids rose from $27 million for 12 projects five years ago to $126 million for 38 projects this year, according to research firm Wood Mackenzie.

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Winds of Policy

Nonetheless, policy in many states continues to push headwinds against microgrid expansion, as Think Microgrid calculated. The State Scorecard's methodology included factors such as deployment statistics, policy and regulatory frameworks, resilience — the existence or lack of a dedicated focus, grid services and equity.

California is noted as a national leader in microgrid deployments with numerous projects both of utility and non-utility origins. However, the Think Microgrid Scorecard gave it an academic average of only 2.8, or a high C. New York and Puerto Rico also received the same mark — with the letter mark averaging out scores in the deployment, policy, resilience, grid services and equity categories — (4 for an A, 3, for a B, 2 for a C, 1 for a D and 0 for F).

More than 30 states received a D grade, while none were marked with the proverbial F. Among the higher Ds were Florida, Pennsylvania, Kentucky and Oregon. The lowest, sharing a 1 average, were seven states — Kansas, Nevada, South Dakota, New Hampshire, Wyoming, North Dakota and Idaho. TDW

Editor's Note: Think Microgrid the industry advocacy group made up of numerous companies and non-profits working in the microgrid space. The non-profit is owned by Endeavor Business Media. Read the Think Microgrid Scorecard at *https://tmi.memberclicks.net/assets/docs/Think_Microgrid_Scorecard_2023.pdf.*

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A Microgrid In Your Back Pocket

It's December and the holiday sales are in full swing as lots of new tech-toys fight for our attention and dollars! Each mail delivery brings new catalogues and flyers displaying the most wonderous gadgets available. There're devices that interact directly with our handheld electronics making them more fun to play with and, in some cases, more capable. The first one catching my attention checks both boxes.

It's a mini photo printer that turns smartphone digital photos into paper prints via Bluetooth connectivity. Another is a tablet-like device that gives you the feeling of an old notepad with a modern twist. The user jots down their thoughts using a stylus on the device's template. They are transcribed directly using cloud connectivity where they are organized and available for distribution.

Modernizing Murphy's Law

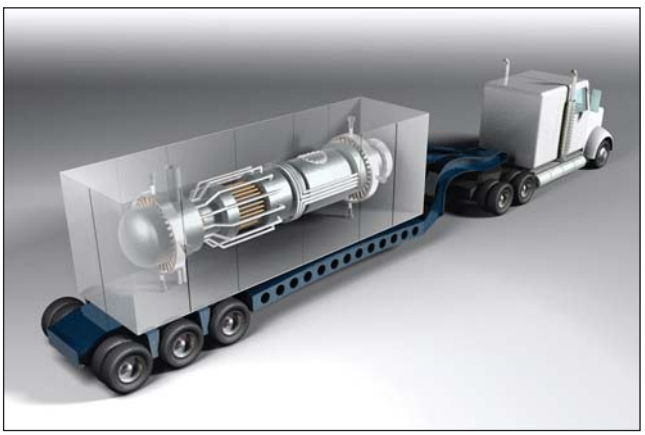
Staying connected is the key, but handheld electronics have an unquenchable appetite for power, and It seems like they always need recharging at the most inconvenient times. Chances are the more you need the device the greater the odds are its battery is almost dead. This must be another corollary to Mr. Murphy's law and if it isn't, it should be! Extreme weather and its power disruptions have increased this problem significantly. There are a couple of handy widgets for our handheld tech-toys designed to combat that condition too.

Pocket rechargers lead the list of practical holiday offerings. These devices are available in a variety of sizes, power capacities, and connection options. Some of the pocket rechargers plug directly into the handheld device's USB port. There are also mini-power banks that come with a variety of cabling choices. But what happens if you forgot to charge your pocket power pack?

Relax, these handy power banks can be found with built in solar panels and there are also foldable solar panels available. Foldables are sized to fit into a variety of small storage spaces like a pocket. Granted it may need a large pocket, but for most of us that's not a problem. By combining mini-power banks with foldable solar panels field personnel have the equivalent of a back pocket microgrid that can be taken wherever it's needed.

Microgrid in a Box

That's really putting resiliency up close and personal, which got me thinking about last September's "Charging Ahead's" feature article about the microgridation of the power grid (Editor's note, see "Charging Ahead" *https://tdworld.com/21271684* for more details). Researching that article turned up some interesting material about a project called "Microgrid In A Box,"



Microreactor. Courtesy of Idaho National Labs.

but it didn't fit with the flow or the space of the article, so I put it aside until now.

The Idaho National Laboratory (INL) is developing a portable self-contained and relocatable microgrid. It can be moved from emergency to emergency quickly supplying power for critical loads. INL uses shipping containers filled with the normal microgrid elements, including batteries with grid-forming inverters. Power can come from diesel generators, hydropower, small nuclear reactors (SNRs), and distributed generation. The utilization of SNRs for a microgrid power supply really caught everyone's attention, but it makes sense.

These SNRs are actually microreactors size wise, and are ideal for a portable microgrid power supply. INL said they are ready to test their "microgrid in a box" using the DOE's (Department of Energy) sodium-potassium cooled microreactor. It will power a 100 kilowatt (kW) linear generator that can be installed in a truck-mounted shipping container. Once again, we are seeing the early stages of a transformative technology as microgrids become portable.

Right now, portable microgrids are definitely a niche device for niche markets, but if you look back about a decade you'll see the stationary microgrids were in much the same position. It's going to be interesting to see if the microreactor is accepted for a portable microgrid's power source. It has a lot of obstacles to overcome, but the benefits are substantial.

I seem to have gotten off my initial subject of back pocket microgrids, but it's not really that far off base. Basically, a microgrid in a box and a microgrid in your back pocket are about accessible power sources. Carrying a microgrid in your pocket to keep handheld electronics operating seems almost as farfetched as parking a nuclear powered portable microgrid next to a critical load to keep it functioning. We have definitely reached the stage where individual solutions are needed for each vital application. The opportunity is at hand and I can't wait to see these two adaptations become commonplace! TDW

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Thyristor-controlled series capacitor. Photo by Gene Wolf.

The Impossible Takes Longer

With all the renewable generation being added to the power grid, there is an increasing need for more transmission capacity.

With 2023 in its final month, there is a great deal of speculation about 2024! What will the new year have instore for the power delivery system? Reading all the predictions, prophecies, and forecasts presents some interesting ideas. In one way or another they all seem to be focusing on the transmission system. That's probably because there are over 2,000 gigawatts of renewable generation waiting to be connected the grid.

According to all the reports, this power is being held up by interconnections queues, permitting, supply chain issues, and the condition of the transmission system itself. So it's a reasonable assumption that addressing transmission bottlenecks will become a higher priority in 2024. It's also a good bet we'll be hearing a lot about the technologies that can squeeze more megawatts out of the existing transmission system and can add gigawatts of capacity to the entire power grid.

Technology to the Rescue

There's an old saying, "The difficult we do now, the impossible takes a little longer!" That could be the mantra of today's amazing new technologies and non-wire alternatives when it comes to addressing the power grid's challenges. What we are talking about are the grid-enhancing technologies (GETs). They have been the subject of numerous publications this past year. Let's look deeper into GETs and get a better understanding of what they are.

Last year, the Department of Energy (DOE) issued a report specifically about GETs titled, "Grid-Enhancing Technologies: A Case Study on Ratepayer Impact." That report looked at the effects of GETs within existing transmission lines and on the customers. It was followed by DOE's draft report titled. "National Transmission Study," which focused on the challenges of an aging infrastructure. Taken together these two publications provide some insightful reading about the transmission systems needs and how to address them. They can be downloaded from the DOE's website for anyone interested.

What are GETs anyway? There are several definitions, but the most common is "Hardware and software that increases the capacity, efficiency, and/or reliability of the transmission grid." That covers a wide bandwidth when it comes to digital technologies used in the smart grid. Some authorities add that GETs provide operational support while larger upgrades are completed, but that gives the wrong impression.

These are not stopgap measures to be removed once legacy technologies have caught up with the transmission grid needs. GETs are proven applications that allow the difficult to be done right now!

They fall into two separate categories when it comes to classifying them. One type of GET are installed quickly for achieving fast results straightaway. The other type of GETs take more time for deployment, but that's because they are more complicated. The complexity, however, comes with paybacks that can't be matched by traditional methods used in conventional transmission lines. These are the applications that allow us to move into what was once considered the province of the impossible, and like the saying goes – that takes a little longer.

Fast-Tracked GETs

One of the exciting aspects of fast-tracked GETs is how quickly they can be installed and start working. These are fast-paced projects that get results immediately, but are receiving pushback from those unfamiliar with the science involved. A great example of this is the dynamic line rating (DLR) technology. Many operators are seeing from 25% to 30% or more of unused capacity in existing transmission lines using the DLR technology.

DLR technology is basically a system utilizing hardware installed on the transmission line to gather real-time operational and environmental data. All of the real-time data is collected and analyzed by sophisticated software, which is then combine with a 3D (3-dimensional) digital twin of the transmission line. The virtual transmission line model uses the data to optimize the loadings of physical transmission line in real-time.

DLR technology has proven itself over several decades of use throughout the world. FERC's (Federal Energy Regulatory Commission) Rule 881 requires transmission providers to implement ambient-adjusted transmission line ratings, which is a boost for DLR technologies. FERC has pointed out that transmission grid congestion would be greatly reduced if utilities/transmission operators were able to tap into this capacity in their existing transmission lines that goes unused today.

Trailblazing GETs

The complex GETs require more time to accomplish their goals, but their results are amazing once operational. A good example would be the FACTS (flexible alternating current transmission system) controllers found in the power electronics family. These devices can shift the flow of power over the transmission system and balance overloaded transmission lines. They include series controllers like the thyristor controlled series capacitors. There are also shunt connected controllers like the STATCOMs (static synchronous compensators) and SVCs (static VAR compensators). In addition, there are combinations of series-shunt controllers like the UPFCs (unified power flow controllers).

Another branch of the power electronics family is HVDC (high-voltage direct current) transmission using VSC (voltage source converter) technology, which is like having a GET on steroids. HVDC-VSC has become the go to technology for developers needing transmission lines capable of moving extremely large blocks of renewable generated power to market. They're flexible and have the ability to push clean power to exactly where it's needed. This past year saw "Charging Ahead" explore several of these HVDC-VSC transmission technologies illustrating its adaptabilities.

The first story demonstrated HVDC-VSC's ability to adapt to the available rights-of-way with "Rethinking Transmission ROW" (for details see *www.tdworld.com/overhead-transmission/article/21255605/rethinking-transmission-row*). A few months later there was "Transmission Lines With A Different Twist" (for details see *www.tdworld.com/overhead-transmission/article/21268392/transmission-lines-with-a-different-twist*). It showcased HVDC-VSC's ability to moved massive blocks of power over extremely long distances. The last article was "Superhighways Are Supercharging The Transmission Grid" (for details see *www.tdworld.com/transmission-reliability/article/21272798/superhighways-are-supercharging-the-transmission-grid*). It featured moving gigawatts of offshore power to market across national borders to load centers far removed from the generation sites.

Moving out of the digital realm, there are some wire-based GETs that are attracting attention. These are the advanced conductors made of modern composite cores and low resistance aluminum wire. They are more efficient than legacy conductors. In addition, they sag less, and have higher power capacities.

These conductors can be used in new construction, but it's the reconductoring of existing lines that is generating excitement with designers. Reconductoring is simpler permitting wise. It also costs less and it's faster to accomplish. Some conductors like ACCC (aluminum conductor composite core) can carry 2 to three times the amount of power compared to ACSR (aluminum conductor steel reinforced) cables.

There's a Third Type

Just when you think a technology fits neatly into a well-defined box, an exception pops up. Grouping GETs into fast-track and slower deployment projects is convenient, but there is a problem. Some GETs start out in the fast-track class, but what happens as their application matures? The fast-track GET becomes more complex and its deployment times lengthen until they are no longer fast-track. Several types of GETs fit into this exception area.

Solar-plus-storage turned microgrid exist as both fast-track and slower deployment GETs. Rooftop solar plus storage leads the pack when in fast-tracking, but when electronics are added they can become microgrids. Many commercial and industrial users have opted for the microgrid option with added capacity to meet their needs. Others found microgrids could be combined making community microgrids. That has matured into neighborhood and town microgrids sized to meet their power needs. It didn't take long for them grow in scale and move to the utility's side of the meter.

In this role, they require more time to design, procure, and install. Still, they are one of the fastest ways to provide resiliency and reliability. Utilities are also using large-scale microgrids to replace or delay needed additional transmission and/or distribution lines. Duke Energy found a microgrid was more flexible than building a second feeder to a remote community in their service area (see "Microgridation Is Changing The Power Grid" https://tdworld.com/21271684 for details).

Last summer, the DOE said the U.S. needs to expand its transmission capacity 60% by 2030 to meet its clean energy goals. With over 642,000 miles (1,033,199 km) of high-voltage transmission lines, that's more than 385,200 miles (620,000 km) in the next six year. According to JP Morgan transmission growth has only been about 1% over the last five years, and that doesn't include the amount of distribution circuits that must be added.

Adding thousands of miles of new transmission and distribution lines is an impossible challenge using traditional approaches for adding to the transmission system. Fast-track GETs can make the difficult happen right away! DRL technologies can add 25% to 30% or more of transmission capacity to the transmission system quickly. Granted that's not the 60% capacity DOE said was needed, but it's about half of the goal and it can happen faster than six years with only one of the available GETs. The impossible can be done with GETs, but it does take a little longer! TDW

Oldcastle Infrastructure:
Replacing Live Critical Infrastructure at Substations

Substations are high-voltage electric systems used to switch generators, equipment and circuits in and out of the electric grid. When substations are not working properly, electricity cannot be measured, and voltage levels cannot be switched or regulated. When this occurs, the power goes out. And when the power goes out, everyone is affected.

Having no access to electricity can be inconvenient and uncomfortable, but for some, it's life-threatening. Nursing homes and hospitals must rely on generators; well pumps cannot run, and traffic lights go out. Moreover, schools, banks and other businesses close. The danger and hardships increase the longer the grid stays down.

"There are approximately 55,000 substations nationwide," says Stephen Kuhn, a regional sales manager at Oldcastle Infrastructure. "The serious problem facing us as a country is that many of these substations are in extreme disrepair. The situation needs to be rectified – and quickly."

Case in Point: Substations in the DC Metro Area

Federal agencies require utilities to identify key substations essential to the performance of the power grid. In several substations in the vital Washington DC region, the concrete trenches housing multiple cable platforms were breaking down and cracking. If the energy provider were to lose a critical substation, it could have disastrous implications for the electrical grid.

To repair these types of trenches, contractors typically remove the trench and in the process disturb the cables. Individual pieces of STAKKAbox were repurposed to make a trench that was high strength while also being lightweight and flexible.

"Oldcastle Infrastructure was approached by the energy provider for a solution to repair a set of critical substations," said Ian Marten, senior product manager at Oldcastle Infrastructure. "It was a very challenging set of circumstances. Trenches physically protect communication cables that control the devices that automate the grid. Replacing these trench systems in the substations safely and without taking an outage presented significant obstacles. Especially when you consider that the critical power surrounding DC is 500 kV."

To repair these types of trenches, contractors typically remove the trench and in the process disturb the cables. Additionally, rebuilding the trenches without disturbing the cables was simply not feasible.

"Any disturbance or break of the existing cables could cause an outage in the substation," said Kuhn. "To make matters more complicated, during the problem-solving stage of the project, we were presented with another unique situation. The site's physical position restricted the ability to use mechanical means inside the substation."

The repair work also had to be accomplished with the substation operating hot. If an outage were to occur, all cabling would have to be exposed, dug up and rerouted, which could take up to a year or more to remedy. This would again mean the loss of power to critical areas.

An Out-of-the-Box Solution

The first two traditional solutions presented, cast-in-place and precast cement, were time consuming and costly. Both were further eliminated by the site limitations on heavy mechanical equipment.

The Oldcastle Infrastructure team approached the drawing board on this highly challenging project with a collaborative, problem-solving framework. Through customer-centric ideation and an innovative mindset, they arrived at an out-of-the-box solution.

"We found a solution to reconfigure our STAKKAbox product," said Kuhn. "Normally used to make highly effective manhole vaults, individual pieces of STAKKAbox were repurposed to make a trench that was high strength while also being lightweight and flexible for decades to come."

The team demonstrated the STAKKAbox Ultima Connect and installed a pilot section to determine if the product would work. Although skeptical at first, the construction team realized the value of the Ultima Connect system and the speed of installation. More importantly, the key requirement of not touching or moving communications cables would be met.

Oldcastle Infrastructure's innovative system replaced the existing trench, while allowing for future expansion.

"We took a product we already had, broke it down, and stretched its capabilities well beyond what it was intended for – all to meet the exacting needs of our customer," said Marten. "Nobody else has a product that can do all of this. It's a product that can be assembled quickly, lifted safely by hand, is non-conductive for added safety and fits beautifully into tight configuration. At Oldcastle Infrastructure, we live to design, create and implement these types of innovation."

Additional Enhancements to the Solution

As it turned out, the substation solution created another whole set of advancements and improvements. To increase safety, orange covers were supplied to give a clear visible signal of pedestrian rating. Redesigning the support beams led to a reduction in weight while allowing for greater room in the interior. And designing new supports helped to ease installation and increase lateral support on the structure.

"Ultimately, we created an innovative system to replace the existing trench, while allowing for future expansion," said Kuhn. "But we also never leave anything to chance. Our customer was convinced the solution worked once we proved the concept on site."

Benefits of Improving the Infrastructure

Safer substation. Because Oldcastle Infrastructure's design-build plan improved safety standards, crews are now able to walk safely around the substation. All cable is encapsulated and extremely well protected. Safety orange-rated covers are now much easier to notice to prevent vehicular traffic.

Better protected grid. The new protective covers are built to last. They will not decay or break down over time.

Zero maintenance requirements for years to come is a long-term benefit the customer can look forward to.

Trusted partnership. The customer came to Oldcastle Infrastructure and asked, "Can you fix my problem?" Oldcastle's philosophy is always to consult closely with the customer and the contractor to problem-solve the solution that best fits the project needs.

Customized solution The flexibility of STAKKAbox Ultima Connect system allowed for the development of this clearly lighter, nonconductive product that can be assembled quickly, lifted safely by hand and fits perfectly into tight, complex configurations.

Blueprint for success There are dozen more substations in the region waiting for this customized fix, some with up to 10,000 feet of trench in substations measuring two miles long. Oldcastle Infrastructure is experienced and ready to take up this challenge and many others.

Robust connections The ability to reach out across the network of CRH companies and innovate together is a key to Oldcastle Infrastructure's operational success. It's all about finding the ideal solution for the customers' particular needs.

To increase safety, orange covers were supplied to give a clear visible signal of pedestrian rating.

Protecting the Grid is Vital

Replacing live critical infrastructures at substations in this case helped to provide safe and reliable energy service to customers in Maryland, Viriginia, and the District of Columbia.

Yet, it is crucial that we continue to protect our critical infrastructure. Especially the grid, which is designed to localize blackouts and prevent one shutdown from triggering a series of others. In 2003, this domino effect occurred during the Northeast Blackout and over 55 million Americans and Canadians were left without power for nearly four days.

According to CBS News, this scenario could happen again. In fact, experts say that the entire U.S. grid could be knocked out in under 20 minutes. This kind of vulnerability underscores the vital importance of a healthy and strong national infrastructure – including substations.

As an industry leader in engineered building solutions, Oldcastle Infrastructure will be there with the expertise necessary to improve how the world is built.

BIDEN ADMIN RELEASES $3.5 BILLION FOR POWER GRID RESILIENCE

Energy Secretary Jennifer Granholm announced $3.46 billion for 58 projects across 44 states to strengthen electric grid resilience and reliability.

The funding, which is part of the Bipartisan Infrastructure Law, will help bring more than 35 gigawatts of new renewable energy online, invest in 400 microgrids, and maintain and create union jobs with three out of four projects partnering with the International Brotherhood of Electrical Workers (IBEW), according to a DOE press conference.

"Today's announcement represents the largest-ever direct investment in critical grid infrastructure, supporting projects that will harden systems, improve energy reliability and affordability—all while generating union jobs for highly skilled workers," Granholm said.

54943987 © Niuniu | Dreamstime.com

The announcements of up to $3.46 billion represent a first round of selections under the broader $10.5 billion Grid Resilience and Innovation Partnerships (GRIP) Program, which is managed by the DOE's Grid Deployment Office.

The DOE provided these examples to show the kind of projects this funding will back:

- Georgia – The Georgia Environmental Finance Authority and the Family of Companies that supports the Georgia electric cooperatives will collaborate on a transformative project to benefit communities across the state through increased reliability and lower costs with an estimated investment of more than $507 million. The project will make a comprehensive smart grid infrastructure update, through investments in battery storage, local microgrids, and grid reliability, as well as new transmission lines.
- Louisiana – Two projects will focus on better positioning disadvantaged communities to withstand extreme weather. The state of Louisiana will launch a strategic initiative with 15 government entities, energy companies, and community and academic institutions to enhance statewide emergency response operations by deploying a network of Community Resilience Hubs powered by distributed energy resources microgrids. These microgrids can stand alone or integrate with utility-owned electric grid infrastructure and back-up generation assets. Under a separate project, Entergy New Orleans will enhance the local grid's resilience to severe weather, including hardening existing transmission lines and distribution systems to reduce outage frequency and duration. It will also deploy a battery backup project that will reduce energy bills for disadvantaged communities.
- Michigan – In Detroit and its surrounding service territory, DTE Energy. will deploy adaptive networked microgrids, which have the capability to adapt to changing energy demands and supply conditions in real-time, especially after extreme weather events. The microgrids will rely on new grid sensing and fault location devices and communication tools that will enhance reliability and reduce the number and total duration of outages in the microgrid areas.

  Consumers Energy will build out much-needed infrastructure investments in some of Michigan's most historically underinvested communities. The project will work to upgrade the backbone of Consumers' circuit systems and increase capacity at local substations to better support redundancy and reliability in disadvantaged communities.
- Pennsylvania – In southeastern Pennsylvania, PECO Energy Company will increase grid reliability and resilience through substation flood mitigation, upgrading underground monitoring and control technologies, deploying battery systems for backup power, replacing aging infrastructure, and installing advanced conductors to increase grid capacity. In eastern Pennsylvania, PPL Electric Utilities Corporation will integrate distributed energy resources and enable real-time grid control to reduce outage duration and frequency, create more than 200 new jobs, and boost electric service reliability for more than 800,000 people.

  In Pittsburgh, Duquesne Light Company will enhance system capacity to unlock clean energy generation and meet targets established in the State's Climate Action Plan while also mitigating customer cost increases, growing high-quality job opportunities and training, and boosting equitable access to clean energy.
- Oregon – Multiple projects across Oregon will connect vast amounts of clean energy to customers and create union jobs. The Confederated Tribes of Warm Springs Reservation of Oregon and Portland General Electric (PGE) will upgrade transmission capacity and connect PGE customers with the currently isolated renewable resources east of the Cascade Mountains, including those on the Warm Springs Reservation—building a bridge to up to 1,800 MW of carbon-free solar resources. PGE will also deploy an artificial intelligence-enabled, grid-edge computing platform to improve the connection of distributed energy resources, such as solar, as well as informed modeling that can predict pre-outage conditions and assist decisions. PacifiCorp will update infrastructure for fire resistance and prevention in Oregon and neighboring states, reducing outages and risks, while also improving flood resilience and creating hundreds of training and employment opportunities in partnership with the IBEW. —*Jeff Postelwait* ■

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QUANTA BUYS PENNSYLVANIA TRANSFORMER MANUFACTURER

Utility infrastructure company Quanta Services Inc. has paid about $300 million for a maker of power transformer, substation units and other components that executives say gives them another "important, secure and domestic supply chain solution" in a growing energy construction market.

Houston-based Quanta used both cash and stock to buy Pennsylvania Transformer Technology LLC, which was founded in 1996 but traces its transformers roots to 1929. The company has annual revenues of about $100 million and runs its main factory—an 18-building, 1 million-square-foot complex that formerly housed McGraw-Edison and Cooper Power Systems—southwest of Pittsburgh as well as a smaller plant in Raeford, North Carolina.

Austin said Quanta is planning to put some more capital to work to boost productivity in Pennsylvania, particularly when it comes to some component production lines. But building scale—or via other acquisitions of transformer companies—isn't a goal by itself, he added.

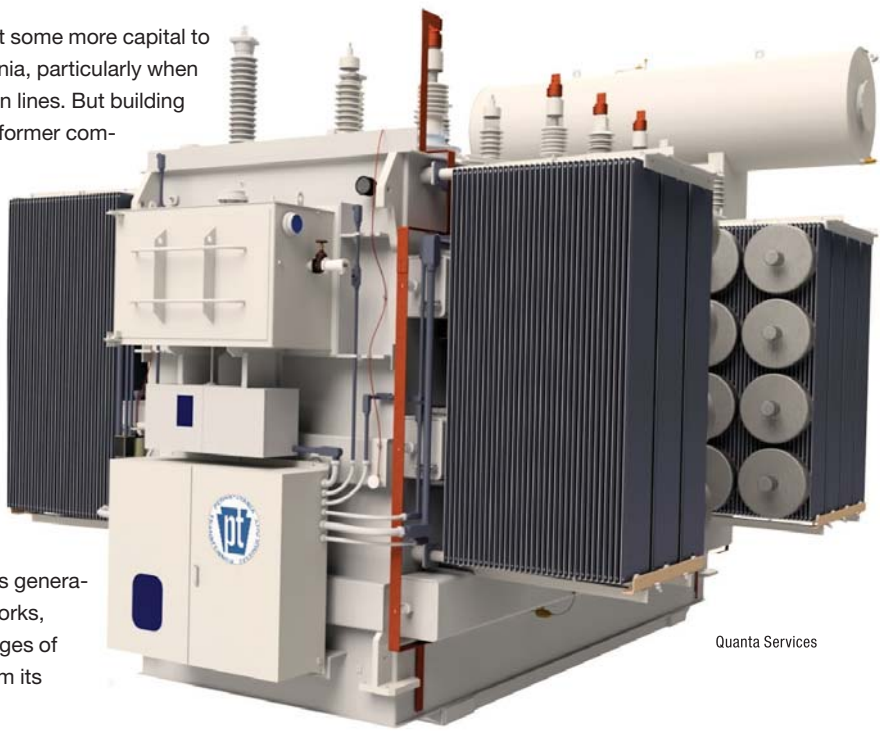
"It's really not about the manufacturing capacity," Austin said. "It's what we can do with it, the synergies we can get with it, with the client."

Transformers have been a pain point for a number of utilities since COVID-19 began disrupting supply chains nearly four years ago. Early this year, several utility officials told T&D World they were being quoted multi-year wait times for new transformers. And with billions of dollars being funneled into the expansion of the country's generation, transmission and distribution networks, the risk of persistent or recurring shortages of various parts and services has risen from its historical baseline.

Austin and his team have for several years been buying companies with ancillary services to address that risk: In 2020 and 2021, their acquisitions included a maker of personal protective breathing equipment, a provider of land services and a California helicopters venture.

For Austin and Quanta, such purchases—as well as the blockbuster $2.4 billion deal for Blattner in 2021—are about growing to meet the size of the energy sector's megatrends. The company now employs roughly 56,000 people—some 7,000 more than just six months ago—and during the third quarter booked a profit of $274 million, up from $156 million in the same period of 2022. Revenues during the period climbed to $5.62 billion from $4.46 billion in the prior-year quarter.

On the back of those numbers, Austin and CFO Jayshree Desai raised their 2023 top-line guidance to a range of $20.1 billion to $20.4 billon. More telling about the future growth, though, is Quanta's order backlog: That finished September at a record $30.1 billion, up nearly $4 billion from mid-year and more than $11 billion higher than a year ago.



Quanta Services

Shares of Quanta (Ticker: PWR) finished Nov. 9 trading at $169.50, essentially flat on the day. They are also unchanged from six months ago—recent concerns about the financials of several renewable-energy projects have soured investor sentiment—which has left the company's market capitalization around $25 billion. —*Geert de Lombaerde*■

PG&E'S POPPE: 'WE DON'T WANT TO HAVE TO MAKE CHOICES ABOUT WHICH ESSENTIAL WORK WE DO FIRST'

PG&E Corp.'s top executives said Oct. 26 they need California Public Utilities Commissioners to quickly reach a "constructive resolution" on the utility's rate case so that its leaders can avoid "difficult decisions" about work to bury thousands of miles of power lines and other safety investments.

Speaking to analysts and investors after reporting PG&E's third-quarter results, CEO Patti Poppe and CFO Carolyn Burke said regulators' responses last month to the company's general rate case application won't steer enough cash to the company in a timeframe that will let it follow through on plans to underground lines and invest in other hardening projects. The CPUC is scheduled to hold three voting meetings in November at which it is expected to make a decision on PG&E's application, which will determine its base revenue through 2026.

A high-profile part of the application is the plan to ramp up undergrounding—work seen as a way to nearly eliminate wildfire risk but costing PG&E about $3 million per mile today—from 350 miles this year to 1,750 from 2024 to 2026. PG&E officials have proposed adding $3.40 to the average customer's bill in coming years to fund that work but the CPUC has recommended (in both a proposed decision and an alternate proposed decision) that PG&E significantly prune its plans.

Poppe said her team thinks those proposals "trade safety and reliability for short-term cost considerations" and also pointed to other elements of the CPUC's response that don't fund required maintenance work. Unless the rate case provides more money more quickly, Poppe said, PG&E will need to scale back its plans.

"We don't want to have to make choices for customers about which essential work we do first," she said. "I have the team here at PG&E who's ready to go, who can do that work for customers that can make the system safer, faster. But we need the cash flow."

Consumer advocacy group The Utility Reform Network last month said that the CPUC's two proposed decisions would add $24 and $28, respectively, per month to the average residential bill and instead called for any increase to match recent inflation readings.

Despite the large gap between her team's plan and regulators' responses, Poppe said Oct. 26 she remains hopeful about upcoming hearing(s).

"We see a path forward to do all of the necessary work that our customers have been begging us to do," Poppe said. "We're excited about being able to do that work, and we're sure that we can get to a good constructive outcome with our regulators."

Oakland-based PG&E on Oct. 26 reported third-quarter net income of $351 million on total operating revenues of nearly $5.9 billion. Profits were down from $459 million in the prior-year quarter due primarily to higher operations and maintenance spending (some of which had been delayed by first-half storms) as well as a $219 million charge for probable losses related to the 2021 Dixie Fire.

Shares of PG&E (Ticker: PCG) ended trading after the company's earnings report and conference call at $15.88, down nearly 2% on the day. They have lost about 7% of their value over the past six months, trimming the company's market capitalization to about $40 billion. *—Geert de Lombaerde* ■

EATON INVESTS $150 MILLION TO INCREASE MANUFACTURING OF ELECTRICAL INFRASTRUCTURE

With a recent venture of $500 million to support electrification, energy transition and digitalization across industries, Eaton has invested an additional $150 million to increase the supply of its electrical power distribution solutions for customers across North America.

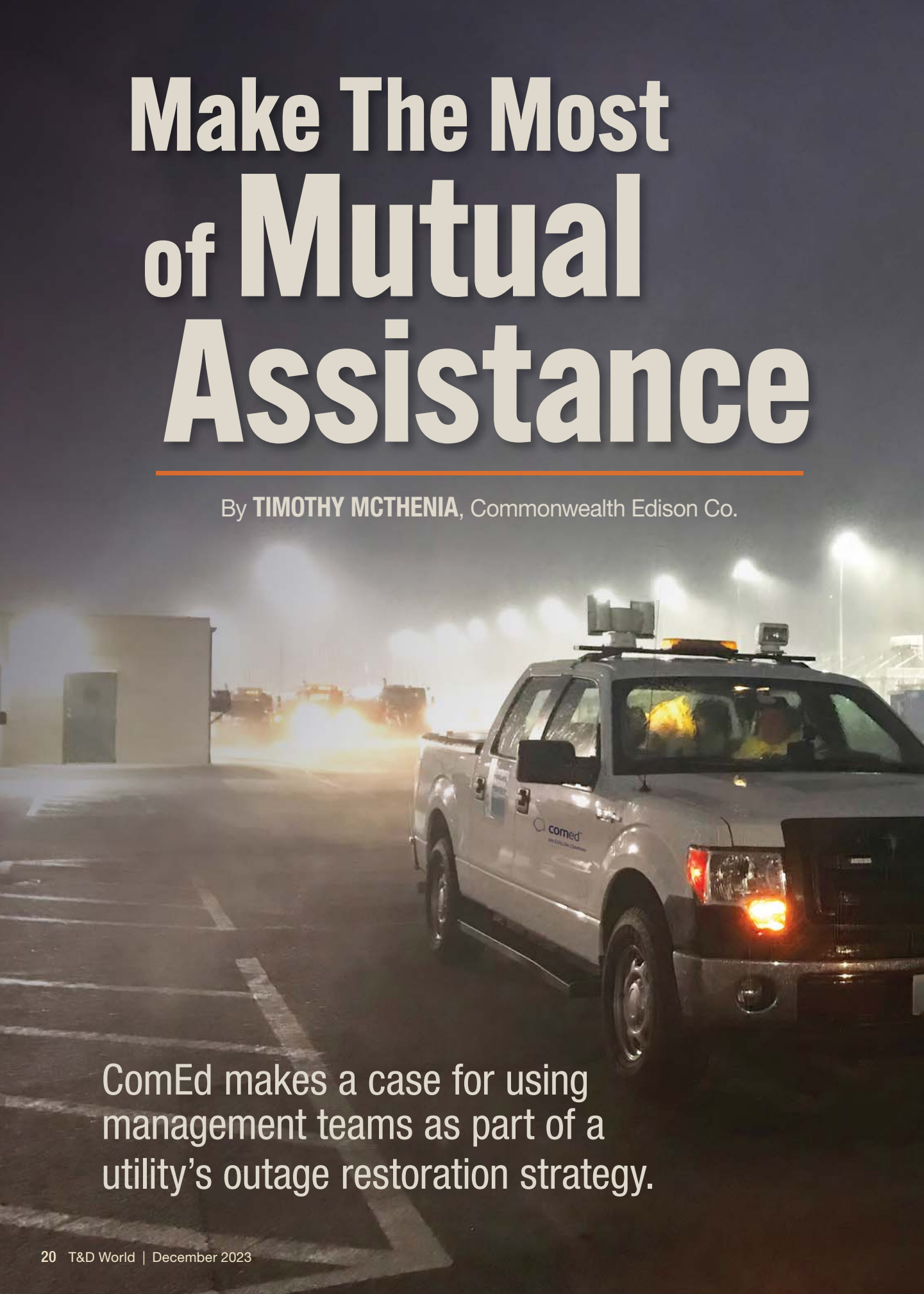
The company is investing $80 million to expand its manufacturing operations in El Paso, Texas to create more than 600 manufacturing jobs, open a new facility and increase capacity at its existing manufacturing plant.

"The latest investment in regional manufacturing reflects our commitment to respond rapidly to unprecedented customer demand and the tremendous abilities of our longtime employees and channel partners," said Mike Yelton, president, Americas Region, Electrical Sector at Eaton.

The expansion plan will help Eaton increase production of its circuit breakers, switchboards, panelboards and other assemblies enabling power distribution for critical infrastructure across industries. Moreover, the company will also expand capacity at its existing facilities in Beaver, Pennsylvania; Juarez, Mexico; Arecibo, Puerto Rico and Haina, Dominican Republic. ■

Make The Most of Mutual Assistance

By **TIMOTHY MCTHENIA**, Commonwealth Edison Co.



ComEd makes a case for using management teams as part of a utility's outage restoration strategy.

ComEd management team vehicles deployed in the field as part of organizing the response to a storm. (Inset) Inside ComEd management team's mobile command center pictured above. Photos by ComEd.

After a derecho struck the ComEd service territory in the summer of 2020, impacting more than 800,000 customers, ComEd utilized an important component of customer restoration: Management Teams. As a result of the widespread damage, ComEd deployed five management teams to direct mutual assistance crews throughout the service territory in which ComEd was able to restore almost 520,000 customers in the first 24 hours.

"In order to ensure we are able to quickly bring power back to customers impacted by severe weather, we continue to explore innovative ways to effectively collaborate with the workforce to deliver safe and reliable electricity," said Vito Martino, ComEd vice president of Distribution System Operations. "These management teams are deployed during significant weather events and provide us the ability to effectively restore customers in a localized, devasted area. Team members have unique skillsets, including leadership, crew management, and system and technical operation. Through deployment of this specialized management team, we can deliver a premier customer experience safely and effectively."

The management team journey for ComEd started in the early 2000s when the ComEd service territory experienced a significant number of customer outages from a severe weather event. Multiple circuits from a substation experienced significant damage, and like most utilities, mainline restoration is managed within the distribution control center. The multiple cases of damage and number of circuits affected required a localized command and control restoration strategy. ComEd came up with a formal plan, including processes and procedures, to transfer designated authority control of all mainline restoration activities from the control center to managers in the field.

Once this process was refined, ComEd took it a step further by creating full-time Management Teams that would respond to areas devastated by weather. Each team member was selected to fill a role. Each role required a specific background for qualification.

Presently, ComEd has eight Management Teams that rotate primary and back-up duties every week. The team has evolved in not only restoring mainline outages but also providing oversight to a large number of mutual assistance crews, restoring all types of outages in a geographical area. In addition, the ComEd Management Teams has been successfully deployed outside of the ComEd service territory, adjusting the processes to however the host utility chooses to utilize the team, while maintaining the core functions and structure of the team.

Mutual Assistance is an important element of storm restoration for those utilities severely impacted by weather events. Requests for Distribution Line FTEs (full-time employees) are submitted and fulfilled through regional mutual assistance conference calls in which utilities in need may be challenged with managing the requested resources to restore their customers in a timely manner. To meet this challenge, the deployment of Management Teams can be utilized to manage the burden of those requested Distribution Line FTEs. They can be a very cost-effective resource for utilities in need of mutual assistance to leverage.

Crews replace poles as part of an outage response effort led by ComEd. Photo by ComEd.

What Is A Management Team?

While various definitions of a management team exist, essentially it is a team of experienced management employees who can be deployed to utilities in need to provide localized command and control of customer restoration using mutual assistance crews. Typically, a management team comprises managers from various functions, such as construction and maintenance, distribution system operations, training and methods, and distribution engineering.

Required qualifications vary by role within the team. However, core qualifications are important for the team to be effective. At a minimum, the team should have a working knowledge of safety rules and work practices, exceptional knowledge of operating and construction work practices, and knowledge of distribution automation reclosers and schemes as well as other protective devices on the distribution system. Members of the team also should be proficient at patrolling feeders, be knowledgeable about restoration strategies, including restore vs. repair, and have a working knowledge of lock-out tag-out (LOTO) programs.

In addition, team members must be able to interpret operating maps, quickly adapt to

the host utility's processes and procedures, and navigate ambiguous conditions and situations. They also must be able to multitask under stressful conditions and provide leadership to both management and union personnel. Furthermore, they should take yearly training on team roles and responsibilities.

Roles And Responsibilities

The makeup of a management team in terms of roles and responsibilities can vary from team to team. However, the core functions of individuals on the team are fundamentally consistent from team to team. The number of FTEs deployed as part of a management team can vary between 10 to 14.

The management team lead oversees the overall management team's activities and performance. This role assumes command and control of the assigned outages, managing restoration strategies. It leads daily team briefings and provides updates to the host utility's leadership.

The team assistant assists in team logistics and securing materials. The assistant assigns, manages and tracks work packages, including estimated restoration times and actual restoration times, as well as determines dig locates. The assistant performs other duties as needed.

The team restoration controller and assessor develops a restoration plan in conjunction with the team lead and mutual assistance crew lead. This role also provides estimated restoration times, performs damage assessment and assesses material needs ahead of crews.

Tornado damage assessment by the ComEd management team. Photo by ComEd.

Bucket trucks lift workers and equipment to repair and replace utility poles and cross arms shattered by a storm. Photo by ComEd.

Services Provided

Because of a lack of resources to manage mutual assistance crews, utilities may be hesitant to ask for the distribution line FTEs required to restore customers in a timely manner, or they may be overwhelmed by the incoming mutual assistance crews. A management team can alleviate the burden of managing additional FTEs, enabling the host utility to bring on more resources and restore power more quickly.

A management team provides localized command and control of a designated area that requires focused restoration efforts because of significant damage. The host utility has a single point of contact when working with a management team, as opposed to having to interact with multiple mutual assistance crew leads. This enables the host utility to deliver one message vs. having to share with multiple mutual assistance companies.

In any restoration effort, crews can get lost in the chaos of a utility trying to manage a considerable number of mutual assistance resources, oftentimes waiting in public view for work assignments. A management team oversees approximately 125 FTE to 250 FTE mutual assistance resources on behalf of the host utility. The team provides localized oversight of the crews to ensure they are engaged and productive. In addition, the management team can stay ahead of crews in terms of damage assessment and securing materials in a timely manner. A crew's next assignment can

already be in the queue, thereby maximizing each resource.

A management team also provides the host utility with end-to-end outage management. To keep the utility's customers updated, the team tracks outages for the utility — including estimated restoration times and subsequent restoration times — in a timely manner. Taking the administrative tasks of obtaining and managing work off the mutual assistance crew lead's shoulders enables the lead to address individual issues or concerns with the utility's crews, such as safety, discipline, meals and hotel accommodations.

Ultimately, a management team drives the restore vs. repair philosophy. Crews like to focus on finding and fixing issues. A management team has the mentality to look for opportunities to open taps, cut in bells and use other methods to restore as many customers as possible before repairs begin.

Successful Deployment

Not every utility in need will use a management team in the same manner. Some may use a team to supplement less-experienced crew guides who have no distribution restoration experience. Some may have a management team work in a given area on lateral taps, transformer and customer-level outages. Others may have a management team take over mainline restoration efforts. While the use of these teams is still not widely understood or utilized, it is imperative the host utility understands the management team concept and how such a team can aid in customer restoration.

Regardless of how a host utility chooses to use a management team, the emergency preparedness department should establish processes and procedures to onboard a management team prior to a weather event . No matter how the host utility chooses to use the team, team members must be able to adapt to the utility's needs.

One of the primary tools of a management team is a mobile command center. Having a fully equipped mobile office located near restoration efforts enables the team to provide a localized command and control structure. In addition, the management team must have a clear understanding with the mutual assistance crew lead the team is working on behalf of the host utility. Establishing that understanding and developing a close working relationship are important elements of restoration collaboration between the management team and mutual assistance crew lead.

With weather events becoming more pronounced because of climate change, utilities will be challenged to develop restoration strategies to satisfy customer expectations on being restored in a timely manner — no matter the damage a utility experiences. With this in mind, deploying a management team as part of a mutual assistance response can be an important part of a utility's restoration strategy. TDW

TIMOTHY MCTHENIA works for ComEd, an Exelon company. He has over 36 years of experience working in the electric utility industry, in which he has held positions in T&D construction for 14 years and distribution system operations for the past 22 years. He also provides managerial oversight to the ComEd management team, in which his team won the Edison Electric Institute Emergency Response Award for its response to Hurricane Ida in 2021.

PacifiCorp crews work on underground cables near a functioning wind farm. Photo by Nathan Etzel, PacifiCorp. (Inset) PacifiCorp's wind power sites have the potential to generate nearly 2300 MW of capacity from more than 1000 wind turbines. 245807497 © Marek Uliasz | Dreamstime.com

PacifiCorp Uses AI To Scan Cable Condition

The utility has updated a technical specification to its medium-voltage cable systems that is projected to save millions of dollars in lost generation revenue.

By **NATHAN ETZEL**, PacifiCorp, and **DAVE MODOS**, IMCORP

PacifiCorp is the largest grid operator in the Western United States, serving the growing energy needs of two million customers while protecting the environment. It is a leader in providing safe, reliable, and sustainable low-cost power, developing innovative solutions and leveraging technology to make the grid more efficient, resilient, and secure. PacifiCorp has an impressive multi-state renewable generation portfolio. Its wind sites alone have the potential to provide approximately 2,300 MW of capacity through the operation of more than a thousand turbines.

In 2019, PacifiCorp was seeking help to determine the cause of several costly cable system failures at an existing wind generation site in Washington. The PacifiCorp renewable generation team learned about IMCORP's work on the distribution side of the business and requested their assistance. Initially, PacifiCorp asked IMCORP to observe cable splice installations at one troubled site. IMCORP engineers quickly identified that workmanship issues were the root cause of the failures and cautioned PacifiCorp that observation alone could not identify the majority of issues. Since there are several blind steps in the installation process, they recommended an AI-based line scanning technology that could repeat the cable and accessory manufacturers' quality control test to ensure cable system reliability of future projects.

PacifiCorp agreed with the recommendations and started to specify IMCORP's cable scanning services to provide a

Table I: Manufacturing Standards PD Test Specification

Cable Component Standard	Parameters (50/60 Hz only)
IEEE 48 Terminations	No PD >5 pC up to 1.5 U0
IEEE 404 Joints	
IEEE 386 Separable Connectors	No PD >5 pC up to 1.3 U0
ICEA S-97-682 / 94-649 Cable 5 kV-46 kV	No PD >5 pC up to 4 U0*
ICEA S-108-720 Cable 69 kV-500 kV	No PD >5 pC up to 2 U0

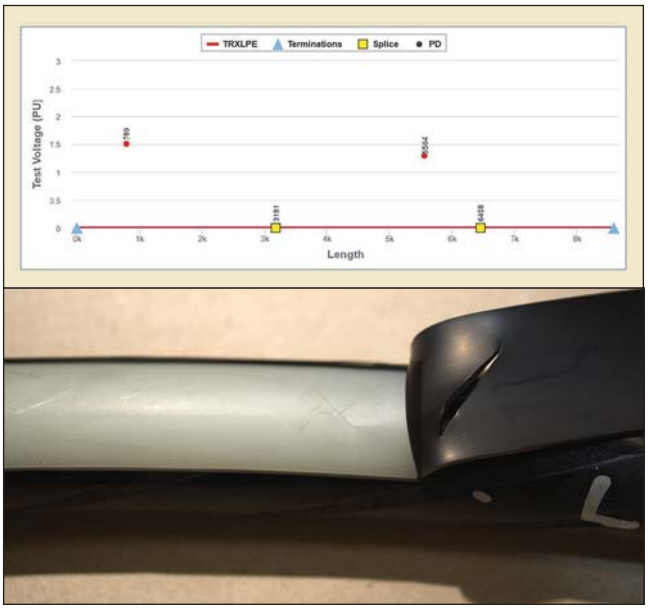
*4U0 is an estimate, actually 200V/mil or 7.9 kV/mm.
Field tests are limited to the level of arrester protection, typically 2 to 2.5 U0

foot-by-foot profile comparable to the cable and accessory manufacturers' tests; offline 50/60Hz partial discharge (PD) test with 5 picoCoulomb (pC) sensitivity.

North American terminations, splices and cables are designed and quality-control tested using the parameters in the table on the facing page. In order to ensure design life performance, cable assets need to meet these standards in the field, and thus effective line scanning technology needs to produce a comparable result and is often specified using "offline 50/60Hz PD test with 5pC sensitivity."

IMCORP provides medium and high voltage (5kV to 500kV) underground power cable reliability services for both new and aged cable system installations. Its technology can provide a foot-by-foot profile of cable systems, which identifies installation, factory, and age-related defects. IMCORP's experience extends across hundreds of thousands of cable systems, thousands of dissections, and root cause analyses on cable system defects and failures. It has commissioned approximately 65% of all U.S. wind/solar sites, serving 40+ owner/developers across over 500 utility scale project sites.

Before engaging IMCORP, PacifiCorp employed a 0.1 Hz Very Low Frequency (VLF) test on their cable collector systems. VLF tests provide confidence that no existing grounds or shorts exist, but typically miss over 99% of defects as defined by manufacturers. Approximately 40% of new installations have at least one substandard component that will experience degradation during a VLF test but in most cases will not be detected, leaving the system vulnerable to failure and significant financial losses.



Example of cable manufacturing defects found in case study one by AI cable scanning and missed by VLF test.

Cable system failures at renewable sites typically cost on the order of $100,000 in lost generation revenue and operating and maintenance (O&M). Cases have been documented up to a half million dollars in losses per failure, especially if the outage is associated with power purchase agreement (PPA) liabilities. Applying an offline 50/60Hz PD test with 5pC sensitivity typically costs less than 1% of the average utility-scale project, can

yield a return on investment (ROI) on the order of 15x, and is essentially a low-cost reliability insurance.

PacifiCorp has used both VLF tests and the IMCORP AI-based offline 50/60Hz PD test at multiple sites, offering side-by-side comparisons of the two approaches. The following case studies are two examples.

PacifiCorp Case Study 1 -Wyoming

In 2020, PacifiCorp was commissioning a new wind generation site in Wyoming, where it employed both the IMCORP line scanning technology and VLF tests. Over 100 miles of cable including more than 300 splices and 700 terminations were installed and commissioned using 0.1Hz VLF tests. All cable systems passed the test with no defects/failures identified. On the basis of the previously mentioned consulting work, PacifiCorp was particularly concerned with circuits containing splices and directed its construction team to test circuits using IMCORP's cable scanning technology. More than 50 splice, termination, and cable insulation defects missed by VLF tests were detected. All the defects were repaired and retested to ensure the final condition met the cable and accessory manufacturers' standards.

Damage to the insulation (off white groove) introduced during the outer semiconducting layer (black) cutback at a separable connector (T-body) termination with substandard performance (per IEEE 386) from Case Study 1.

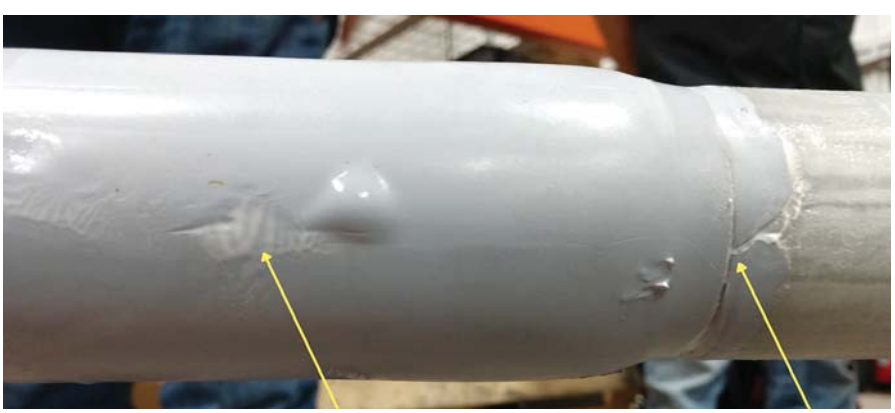
Some defect samples were extracted and sent to the IMCORP root cause analysis laboratory, where it was determined the root cause of the cable defects was manufacturing errors, whereas the root cause of the substandard accessories was installation error.

These findings only underscored the value of using factory comparable cable scanning technology capable of detecting defects before failure, with all the evidence intact. Both the field and laboratory dissections provided PacifiCorp and its contractors with an accelerated constructive feedback loop on the cable system product selection, design and installation quality. Energizing a system with defective components can lead to costly failures and collector system downtime, both in the short and long term of the system's life. Due to these results, PacifiCorp has enforced its offline 50/60Hz PD test with 5pC sensitivity specification to commission its medium-voltage feeder systems. PacifiCorp has experienced no failures at this this site since energization.

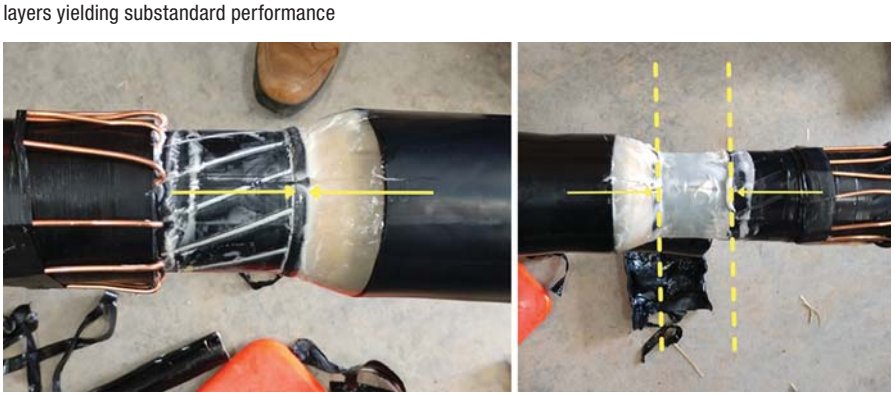
PacifiCorp Case Study 2 - Wyoming

In the second case study, three sites of similar scale (A, B, and C) were built to the same specifications using the same design, components, and installers. VLF tests were conducted on Sites B and C, including more than 120 miles of cable systems, and no defects were detected. PacifiCorp purchased Site A from the developer and specified an offline 50/60Hz test with 5pC sensitivity to commission nearly 66 miles. The cable scanning technology located hundreds of defects, including 32% of the site's splices. At first the installers were in a state of disbelief that all the splices passed on Sites B & C and so many splices did not meet the manufacturer's minimum performance requirements (IEEE 404) on Site A. An onsite dissection and root cause analysis showed that installation errors were the cause of the substandard performance. The onsite dissection allowed the installers to be re-trained and coached on the proper installation. To demonstrate the splices could be installed to manufacturers' standards, a control splice was installed under supervision, and a subsequent test demonstrated that it easily surpassed the manufacturers' performance expectations.

After repair or replacement, Site A's substandard components were retested proving they now met manufacturers' standards. The ability to use IMCORP's



Case Study 2 common splice installation defect 1: impressions and dips in the mastic creates voids between layers yielding substandard performance



Case Study 2 common splice installation defect type 2: Uncentered splice body. No gap (left) and too large of a gap (right) which misalign the stress control and yield voids under the splice body and result in substandard performance.

cable scanning technology during commissioning provided a valuable feedback loop to installers and proved to be an invaluable training tool to correct and improve craftwork in real time.

Site A, commissioned by IMCORP, experienced no failures post-commissioning but sites B & C, commissioned with a VLF test, incurred 14 failures on splices. Over the operations period, this equates to a failure rate of 5.3 failures/100 miles/year. The cost of each failure in O&M and revenue losses was estimated at over $100,000, bringing the total impact to over the million-dollar mark.

Onsite repair of splices that had been exhibiting PD and were performing below manufacturer's standards. IMCORP's PD test confirmed repaired splices were PD free to 2.0Uo. Photo by IMCORP.

Conclusion

Armed with the knowledge that over 90% of cable failures are a result of issues that are preexisting or introduced at the time of cable system installation, as well as understanding that not all cable testing is equal, PacifiCorp now specifies offline 50/60Hz PD testing with 5pC sensitivity to commission all medium-voltage feeder cable systems. TDW

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Preparation for placement of equipment at BGE's Chesapeake Battery Storage System site. Photo courtesy of SEPA.

BGE Plans for Equitable Resiliency

SEPA and BGE pilot a tool to deliver resilient energy that is both cost effective and sustainable.

By **ETHAN HOLMES**, Baltimore Gas and Electric, and **JARED LEADER**, Smart Electric Power Alliance

The call for net-zero electric systems is clear within the current energy industry. Utilities are focused on restructuring their energy portfolios to help them meet their company, state and federal sustainability goals. 83% of U.S. customer accounts are served by a utility with a carbon-reduction target. A swift transition to a carbon-free system also requires utilities to focus on designing a climate-resilient grid while ensuring everyone reaps the benefits.

BGE's Chesapeake Battery Storage System site. Photo courtesy of SEPA.

For SEPA, the primary macro drivers in the utility transition are decarbonization, electrification and decentralization. Utilities, however, have many opportunities afforded to them to address these forces, including load flexibility, innovative rate programs, bidirectional flow, and dispatchable distributed energy resources.

The data is definitive: as a consequence of significant greenhouse gas emissions, climate change is now progressing at a faster rate than at any other point in history. As a result, there has been a clear increase in the frequency and cost of extreme weather events in the U.S., and utilities are now developing climate risk and adaptation plans.

Over the last 40 years, there has been a large upward trend in the frequency of and costs associated with severe weather. As weather events intensify, the resilience of our energy infrastructure becomes paramount. Utilities work tirelessly during these disasters and are increasingly focusing on powering critical facilities and prioritizing restoration. The key is ensuring this restoration happens swiftly, ensuring no community is left in the dark.

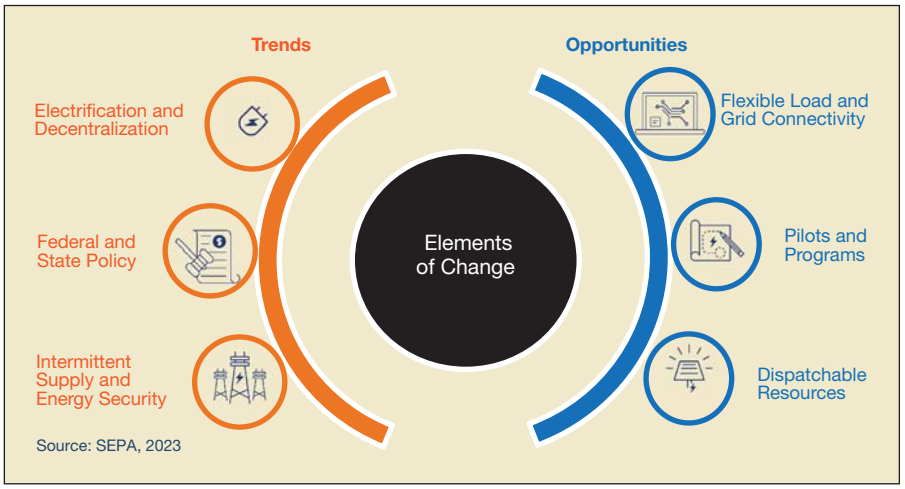
The question remains, how can utilities incorporate resilience and equity alongside the traditional tenets of electric power affordability, reliability and safety.

The Need for Resilience

The aftermath of these extreme weather events is not confined to the grid; it reverberates through communities. The ability of

the grid and communities to withstand and adapt to these challenges defines their resilience. Each person possesses unique levels of exposure, sensitivity and adaptability, making their communities a tapestry of individual levels of resilience.

Exposure is defined as the characteristics of one's environment and proximity to hazards. Increased exposure to factors such as high winds, extreme temperatures and severe storms increases the risk of damage to critical infrastructure and prolonged outages. Some communities are home to more sensitive populations and will have a difficult time dealing with damage and outages.



Utility transition trends and opportunities. Graphic by SEPA.

Sensitivity is defined as the degree to which people and places can be harmed. Populations that are dependent on power for medical and accessibility services are at risk of compromised health and safety, whereas less sensitive populations may only experience mild discomfort during an outage.

Adaptability refers to the capacity of a community or system to adjust to changing conditions. The resilience factor that utilities can control is adaptability. Utilities can improve the grid's adaptability by deploying flexible and dispatchable distributed energy resources to communities, making them less vulnerable to grid stressors such as extreme weather events.

To better understand the resiliency status of the grid and the communities it serves, utilities and states across the country are collaborating with SEPA resilience experts.

SEPA's Approach

SEPA's mission champions the clean and smart transition of the energy system. The "S" in SEPA stands for "Smart," which incorporates the core tenets of utility planning: affordability, reliability and safety. This means a clean energy transition, but not at all costs. The metrics of resilience and equity are integral to distribution system investments. The future of resilience doesn't lie solely in traditional methods. Utilities must juxtapose traditional resilience investments, such as grid hardening and undergrounding, against non-traditional forays like solar PV projects and energy storage.

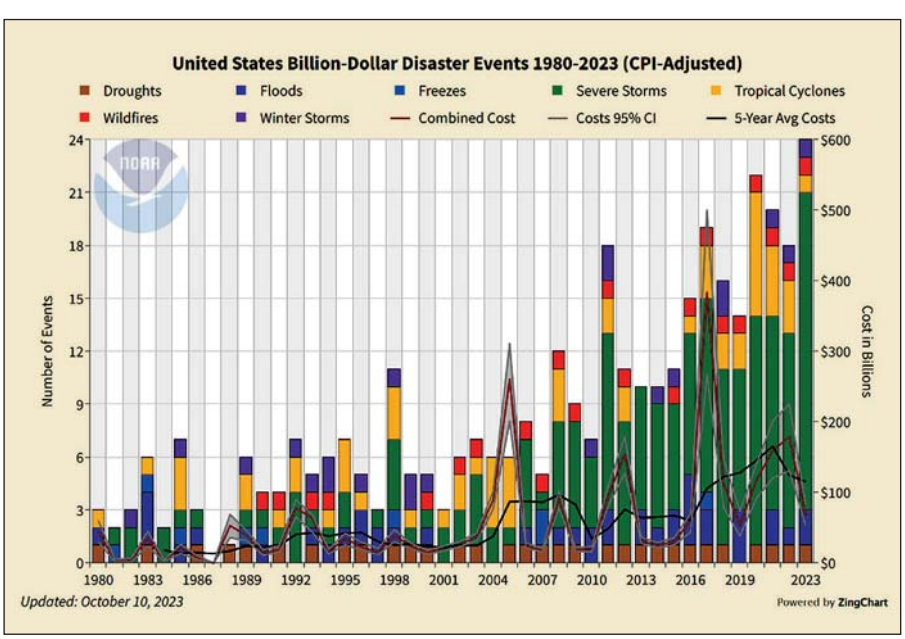
Building Resilience

Resilience is multifaceted. It is about the grid's strength, the duration of extreme weather events, and the grid's adaptability. Adaptive capabilities might encompass redundancy, localized generation, storage, distribution automation, and techniques for grid hardening.

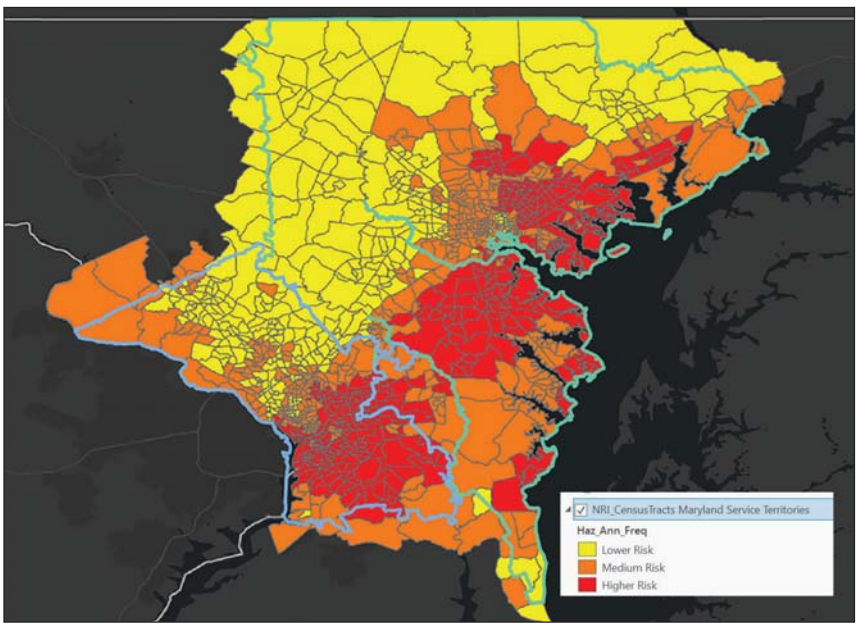
This paints the picture of the resilience needs for a utility. SEPA and its utility partners are reimagining distribution system planning. This doesn't mean compromising on affordability, reliability or safety. It's about enhancing the planning process with the lenses of resilience and equity.

Every utility prioritizes essential customers, yet their definitions of "critical" can vary. After the COVID emergency, essential businesses like banks, grocery stores, and gas stations have taken center stage during emergencies. It is essential for utilities to continually re-evaluate and integrate varied perspectives on what is deemed critical.

As utilities have these conversations, state emergency management agencies, large energy users, local emergency planners, community-based organizations, consumer advocates and environmental advocates are all examples of organizations that should be at the table. Both in-person and virtual forums can be effective at collecting stakeholder input to make better informed decisions around "critical" and "essential" businesses. SEPA has



Billion-dollar weather and climate disasters over time. Graphic by NOAA National Centers for Environmental Information.



Hazard across BGE's Maryland service territory. Graphic by FEMA's National Risk Index.

also employed surveys as a mechanism allowing stakeholders to rank and prioritize the criticality of facility and facility types, and to collect data on these facilities.

Meeting Mandates

The rise in public utility commission (PUC) regulatory directives and state energy office funding for resilience investments within disadvantaged communities is noteworthy for utilities as grant recipients and/or partners. There is approximately $13.5 billion in funding from federal and state governments for enhanced grid resilience, with an emphasis on communities disproportionately impacted by climate change and power outages.

With the federal government mandating that 40% of all funding should flow to disadvantaged communities, utilities are grappling with this new layer. Hence, the importance of overlaying natural hazard risks with service boundaries and disadvantaged community data to pinpoint resilient zones for strategic investments.

The emphasis on resilience must also include a focus on societal equity.

With states beginning to increase support for disadvantaged communities, it is evident that not only is the federal government putting out these mandates for equity; states are focusing on these communities disproportionately impacted by climate change power outages. Drawing from SEPA's hands-on experience, utility partners in Maryland, Virginia and Pennsylvania are beginning to look at how this data is overlaid in their own communities.

The journey towards a resilient and carbon free grid is not without challenges. Yet, with the emergence of technology such

as longer-duration energy storage, the path is becoming clearer. Utilities can leverage these types of grid assets and customer assets for virtual power plants, delivering solutions that are both sustainable and resilient.

SEPA's Five Focus Areas. Graphic by SEPA.

Approach in Practice

In the ever-evolving utility planning landscape, access to accurate and intuitive tools can make the difference between a project's success or failure. As the energy sector charts its course towards a carbon-free system, the onus is on utilities to ensure that the transition is not only swift and sustainable but also equitable and resilient. SEPA's process and approach, or our toolkit as we call it, offers a fresh perspective compared to traditional resilience studies.

- **Focus:** While traditional studies recommend specific suites of projects, SEPA identifies locations ripe for resilience opportunities.
- **Scope:** SEPA's study is technology agnostic and primarily evaluates non-wires solutions such as energy storage, solar PV, and microgrid projects, whereas traditional studies zero in on wires solutions.
- **Equity:** A defining feature of SEPA's approach is its incorporation of state and federally defined environmental justice and disadvantaged communities, a facet often overlooked in conventional studies.
- **Granularity:** SEPA's approach goes beyond utility infrastructure, integrating critical customers and facilities, and prioritizes locations and potential opportunities for customer-sited, circuit-level, and/or substation-level solutions.

BGE partnered with SEPA to explore this approach. This partnership wasn't solely focused on pinpointing resilience investment opportunities; it's reimaging traditional planning efforts to pilot new processes.

This approach re-imagines the same process with new data layers, not excluding any important key values or key core tenets like affordability, safety and reliability. BGE is committed to continuing improvements that will enhance reliability, safety and resilience of the electric and natural gas system serving 1.3 million electric customers and 700,000 natural gas customers in central Maryland. As part of the utilities' commitment to these principles, this partnership has leveraged this toolkit to make informed decisions prioritizing the needs of disadvantaged communities, as well as laying the foundation for the infrastructure work necessary for the State of Maryland to be able to meet its net-zero emissions by 2045 goal. This exercise has shed light on areas that require attention by providing a roadmap for actionable steps.

BGE's strategic planning team was able to immediately see the impact on floodplains and realize how disadvantaged communities had been left behind by Baltimore's history of redlining. This tool has shown the team that a lot of research time can be saved since the information is already packaged.

Making Informed Decisions: This toolkit's efficacy was evident when BGE was faced with prioritizing potential sites for federal funding opportunities.

With six sites to choose from, the tool helped BGE select the most disadvantaged and impactful location for a resiliency project. The tool directed BGE to an area bordering two disadvantaged communities in a climate floodplain. This underscored the toolkit's potential to house everything in one place, streamline and deepen the impact of processes. The tool illustrated how quickly the utility could pinpoint locations for resiliency projects, saving countless hours.

Broadening Horizons: BGE's collaboration with SEPA and the use of their toolkit is facilitating in-house projects and paving the way for external collaborations. Currently, BGE is collaborating

Grid needs toolkit. Graphic by SEPA.

with organizations on similar partnerships for resilience hubs and energy storage projects. The utility is piloting the tool to confirm its effectiveness and is confident in its potential to quickly identify key issues. The toolkit's potential extends beyond mere infrastructure planning. It plays a pivotal role in identifying customers disproportionately impacted by climate events enabling utilities take preventive measures.

The Road Ahead

Resilience is intertwined with every facet of the clean energy transition, from electrification to storage. Emerging technologies are key in this transition. Effective policies and stakeholder collaboration will be pivotal in achieving a carbon-free future.

The partnership between BGE and SEPA epitomizes the transformative power of collaboration and innovation. As the energy sector evolves, tools like the SEPA toolkit can be instrumental in ensuring that the transition is sustainable, resilient and equitable. TDW

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JARED LEADER (*JLeader@sepapower.org*) is senior director of resilience at SEPA. In his role, he facilitates utilities, industry, regulators, legislators, customers, and other energy stakeholders toward a carbon-free and resilient energy future. Prior to joining SEPA, he spent several years working for utility, municipal and industry stakeholders in the energy and water sectors. He has a MS, Energy Policy and Climate from Johns Hopkins University, and a BS in Civil and Environmental Engineering from the University of Virginia. In 2021, Jared was recognized by PUF's Fortnightly Under Forty list of energy and utility professionals.

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(Top left) When the first version of the NESC was released in 1913, the standards were characterized by a changing network structure that was the result of rapid electrification and the running of utility lines through previously installed wooden telegraph poles. 24984686 © Bronwyn8 | Dreamstime.com.
(Bottom left)Aging distribution poles have become a major impediment to power grid reliability. 46092518 © Aleksey Popov | Dreamstime.com.
(Right) Crews replace a distribution pole in New Orleans in January 2023. Most of the U.S.'s utility poles have been in use for 50 years to 60 years, which raises concerns about resiliency when considering the biological life expectancy of wood. 268123413 © William Morgan | Dreamstime.com

NESC Progresses Power Grid Resiliency

The NESC focuses on standards that help to increase worker safety while improving power grid resiliency in overhead utility pole networks.

By **WAYNE HALL**, IEEE SA

In recent years, power grids and utility networks across the globe have undergone unparalleled amounts of stress and are today experiencing issues never seen before to this degree. Extreme temperatures, unprecedented natural disasters, increased global energy consumption and aging utility networks are just a few of the many elements causing major issues within power grid networks worldwide. These issues have brought the topic of power grid resiliency to the forefront of industry discussions and made it the focus of many power and utility organizations.

Specifically, the issue of aging wooden utility poles and their increasing vulnerability has become a major obstacle to grid resiliency. With this and other sources posing new and unforeseen threats to the grid every day, improvements must be made to improve the resiliency and overall life span of power grid networks, including what types of power poles are used to deliver electricity. Numerous organizations, standards, safety considerations and environmental conditions play important roles in the current landscape of power grid resiliency.

In practice, power grid resiliency involves protecting the network from potential issues and disruptions through careful planning, preparation and allocation of available resources. At any point in the network, from generation to transmission to distribution, the network can be attacked, be compromised or malfunction in some way. Some of these issues are not uncommon and can be prevented during routine maintenance or fixed at the source by a field electrician. Other issues are more complicated and serious, causing major outages and wiping out entire networks. To prepare for this, the industry needs to implement and invest in resiliency improvements, designing networks with a certain amount of redundancy that enables the grid to be more easily restored when an event occurs.

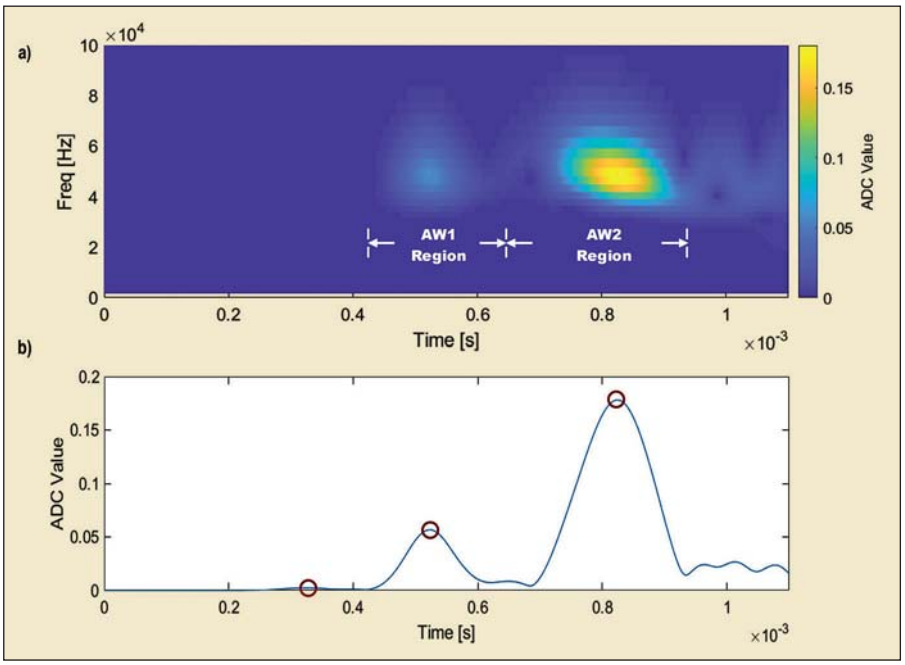
Resiliency Guidance

Exploring resiliency among other things, utility and energy organizations have worked for many years to develop standards and operational guides that prescribe best practices for the safest,

most effective management of every part of the power and utility system.

One of the most well-known and adhered-to codes is the National Electrical Safety Code (NESC), published exclusively by the IEEE Standards Association (SA). First developed in 1913, the NESC sets the ground rules and guidelines for practical safeguarding of utility workers and the public during the installation, operation and maintenance of electric supply, communication lines and associated equipment. The guide, a working document updated every five years to account for changes in the industry and technology, has begun to dive more deeply into threats to the network and overall power grid resiliency in recent years.

Today, power grid resiliency and safety, as prescribed by the NESC, are inextricably linked as the utility landscape continues to change rapidly and face novel issues. The overall level of safety within the utility industry increases and will continue to do so as resiliency improvements are made, but such improvements cannot be made without adhering to the most recent, innovative standards in the field.

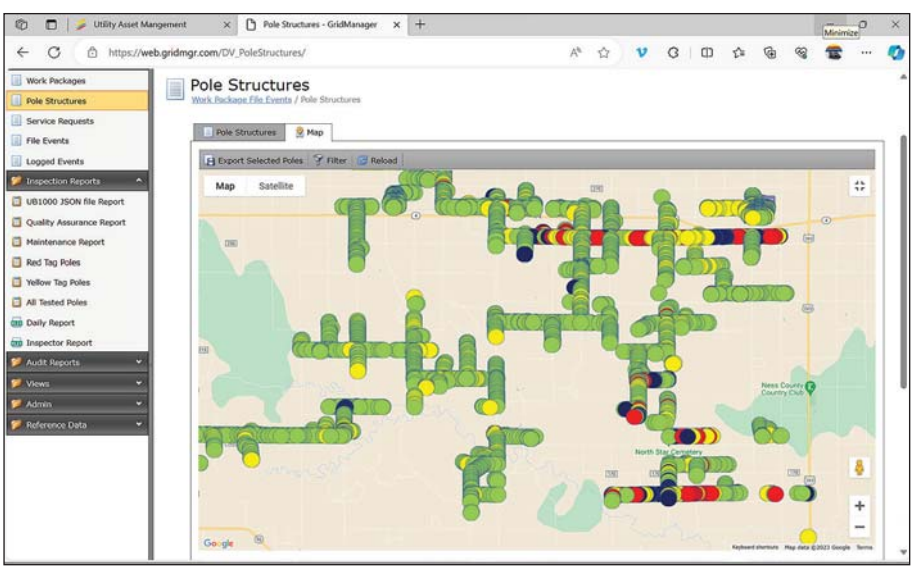


Correlation analysis of ultrasonic stress wave characteristics and destructive strength measurements in cylindrical wooden structure. Graphic by IEEE Journals & Magazines | IEEE Xplore.

Aging Overhead Network

A critical area in which the NESC addresses and works to progress power grid resiliency is overhead utility pole networks and worker safety. When it comes to utility poles, a slowly developing but growing obstacle the industry faces is the aging of the entire

Pole break and material density study by Mississippi State University. Photo by NESC.



IEEE member's resiliency map. Graphic by NESC.

overhead utility network. When the first version of the NESC was released in 1913, the standards were aligned with that era, characterized by a changing network structure that was the result of rapid electrification and the running of utility lines through previously installed wooden telegraph poles.

However, a key driver of the utility pole network known today came with the Rural Electrification Act of 1936. The act laid the groundwork for widespread expansion of the network, with most infrastructure completed by the 1970s.

As of today, most of the U.S.'s utility poles have been in use for 50 years to 60 years, which raises concerns about resiliency when considering the biological life expectancy of wood. The life span of a wooden pole is expected to be around 60 years to 70 years in terms of its structural integrity and strength. Thus, with most utility poles being installed by the 1970s, almost 54 years ago now, and the average life expectancy of a wooden pole being around 60 years to 70 years, this means most utility poles in the network are in the last third of their life cycle.

As these poles get closer to the end of their life span, their structural integrity and ability to withstand harsh conditions and major disruptions continues to diminish. Pair this with the uptick in recent years of extreme weather events, and it becomes a dangerous combination that has created widespread power issues and unsafe work environments for electrical workers.

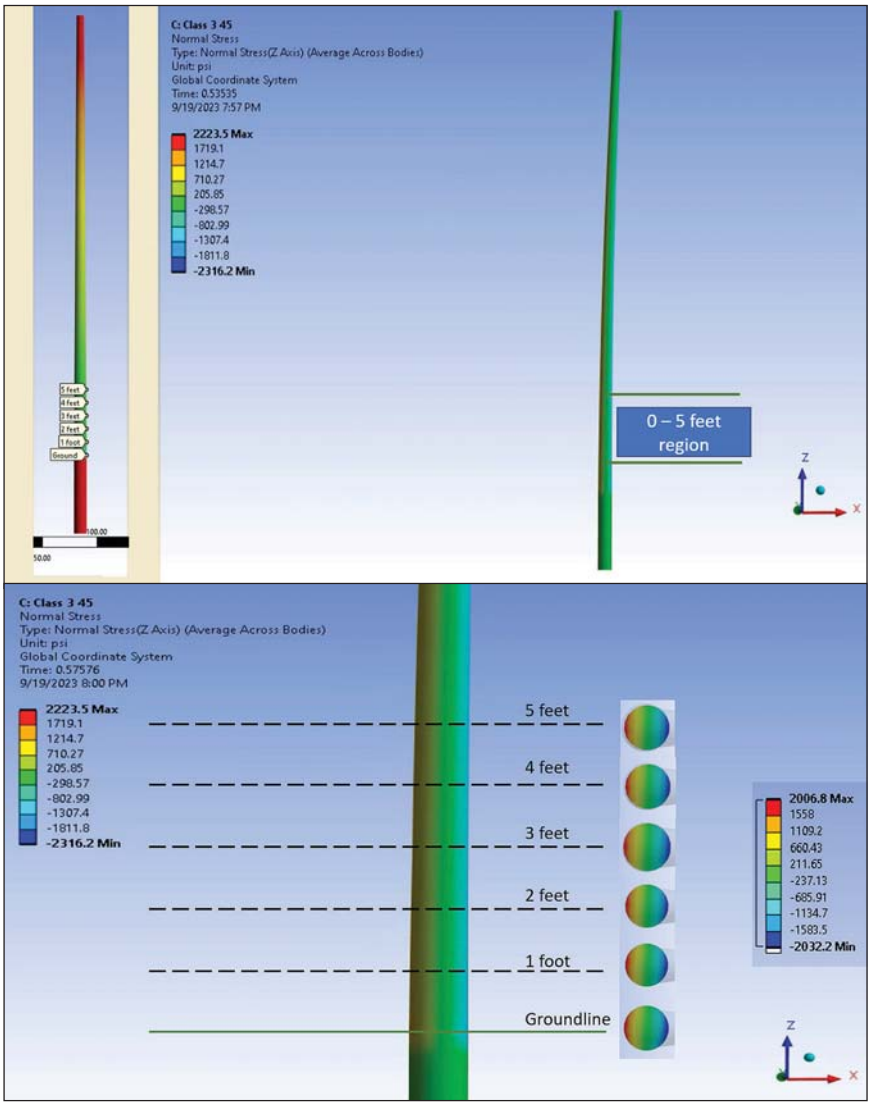
Searching For Solutions

With power problems predicted to continue and become more frequent as utility poles age, efforts to improve the resiliency of utility pole networks and the overall power grid have increased. Industry experts, like those from IEEE SA who contribute to the NESC, are continuing to look for novel methods, technologies and innovations that can improve the strength and resiliency of aging utility poles. For example, some researchers are looking into creating a digital twin of the base infrastructure of a utility system, so it can be integrated into other parts of the system like the pole networks.

Other organizations are conducting analyses to determine the ages of poles in different parts of the network to identify where the stronger and weaker sections are. This information can be sent to utilities, so they can properly distribute resources to conduct maintenance on and install reinforcements to the oldest and most vulnerable poles in their network.

Other areas of research are looking to improve pole resiliency by finding material alternatives to wood that are more durable but also can withstand the conditions of electrical transmission. Materials like fiberglass, concrete and more have been tested to determine whether they are viable alternatives to wood, but each has been found to come with their own set of issues that can create problems and lead to failure.

Steel trussing is commonly used for network hardening as well as pole restoration. Photo by NESC.



Pole deformation analysis (Top). Theoretical break-point analysis (Bottom). Graphics by Dr. Yishi Lee.

To further the search for standardized solutions to pole aging, a recent study was conducted by Mississippi State University on a sample of utility poles that had been in service for varying amounts of time to see how excessive conditions and loads would affect breaking and failure. Of the poles, 16% broke between 6 inches (152 mm) below and 12 inches (305 mm) above ground line (AGL), 63% broke between 1 ft to 4 ft (0.3 m to 1.2 m) AGL. The remaining 21% broke above 4 ft AGL. This result was expected, as a pole that is 60 years to 70 years old cannot be expected to be capable of carrying the same load as a pole that has only been in the ground for 5 years to 10 years. Other studies of a related nature have yielded similar results, demonstrating the potential catastrophic effects of pole aging.

Based on the Mechanical Properties of Wood, a report published by the U.S. Department of Agriculture Forest Service on Douglas fir, a simulation was built according to the ASTM for standard test methods of static tests of wood poles (ASTM D1036-99, 2017). The result of the simulation suggested a similar cross-sectional stress level occurs from ground level up to 5 ft (1.5 m) AGL. This conclusion agrees with the break test result, which showed 63% of the poles break between ground level and 4 ft (1.2 m) AGL.

Operational Resiliency

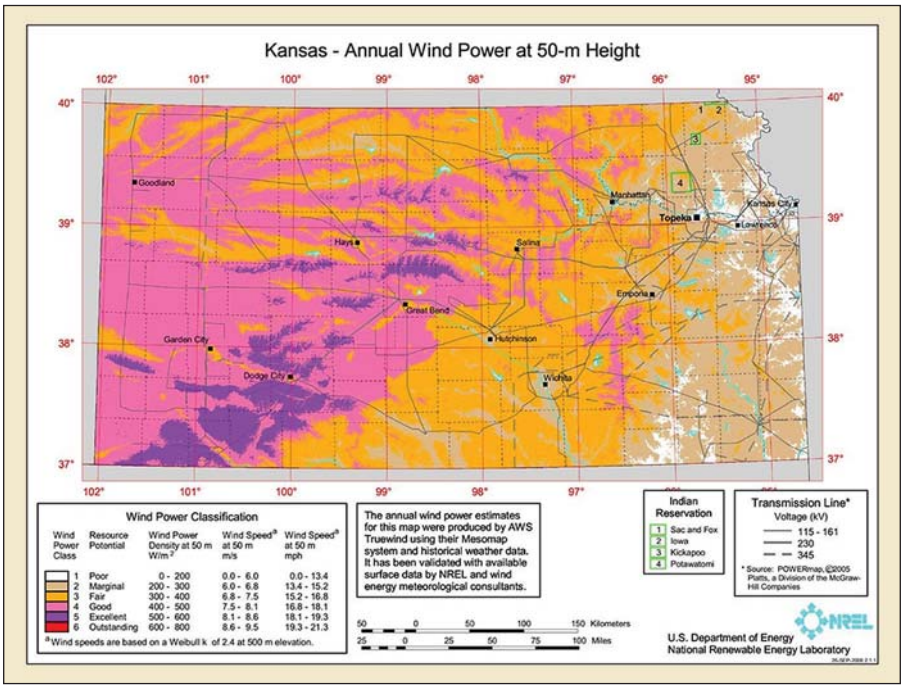
The NESC actively works to address findings from research and testing by standardizing methods for reinforcing the overhead utility pole and line network to make it more resilient to complications. Section 8 of the code looks at overhead utility lines and ratings that measure operational resiliency. It includes standards that detail network hardening plans and systems that include class upgrades for aging poles that protect legacy electric lines in high wind areas.

Section 8 also targets resiliency through standards that delineate targeted trussing of weak poles. This involves not replacing the poles themselves but rather installing trussing along key poles that can prevent catastrophic fails and domino effects. This way, networks can potentially lose two poles or three poles instead of 50-plus poles, enabling utilities to minimize the damage and recover from an adverse event more quickly.

All the standards detailed in section 8 use different methods to build strength within the network and make the grid and utility pole network more resilient by reinforcing weak parts of the network. Such methods are crucial to the overall advancement of network resiliency across the globe.

Future Focus Areas

Finding novel solutions to improve resiliency of utility poles networks will continue to be of high importance in the coming years. When looking toward the future, making predictions on possible solutions for improving wooden pole resiliency will be heavily based on future weather, environment and technological advancements. With the chances of massive changes in weather events being high, power grid — and specifically pole



Map shows annual average wind speed in Kansas at 30 m. Graphic by NREL.

— resiliency is going to be extremely important and something the NESC helps to address and will continue focusing on in future iterations.

Based on current patterns, future versions of the NESC are likely to contain specific changes and more detailed standards related to resiliency. One prediction is designated loading zones and guidelines for determining these zones will change. This can safeguard networks by distributing loads more evenly across the network and away from weak points more susceptible to issues. Teams will have to identify how the zone changes affect loads for the overall network to ensure they are reinforcing, and not hurting, overall resiliency.

In relation to aging utility pole networks and grid resiliency, the NESC also works to address worker safety standards that detail best practices for safely approaching and performing all electrical work. Section 4 of the worker safety portion of the NESC, which was updated in 2023 to reflect the most recent landscape, addresses workers being well equipped and prepared for the job and task at hand. With extreme weather events sweeping across the world and bringing network repairs and resiliency concerns to the forefront, it is important electrical workers have the right tools and equipment as well as follow the proper procedures to deal with such specific issues and tasks. By identifying upcoming weather patterns and threat-heavy seasons, utilities can modify their preplanning and deployment processes to prepare for these events, allowing them to better protect and ensure the safety of their employees.

As more organizations begin to implement section 4 standards that call for advanced preparation, comprehensive equipment lists, and detailed task and safety procedures, grid resiliency will become more easily attainable with a more prepared, protected and resilient workforce. In future NESC editions, resiliency concerns will drive further evolutions to section 4 and include requirements for more extensive safety equipment and more safety precautions for workers to follow.

Overall, the growing variety of unforeseen conditions that are becoming increasingly threatening to the health and stability of global utility networks and power grids worldwide calls for widespread action. IEEE SA's work within the industry through the NESC and other publications will continue to target power grid resiliency and establish standards that prescribe the safest ways for improving the network now and in the future. TDW

WAYNE HALL (*wayne.hall@utilityassetmanager.com*) is a member of IEEE SA and the current President of Utility Asset Management Inc., in Denver, Colorado. Currently, Wayne is named on four US patents related to using ultrasound on wooden structures. He is also a qualified supervisor in wood preservation and wood products treatment (Colorado), is an FAA qualified drone operator, and was one of the reviewers for the Colorado Department of Agriculture's recently released Colorado Wood Products Commercial Pesticide Application and Safety Training Study Guide. Wayne has an undergraduate degree and a post graduate diploma in business from the University of Auckland and is a certified PMP (Project Management Professional) through the Project Management Institute.

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Line Trade Unites at 2023 Rodeo Week

OUR DECEMBER FEATURED LINEWORKER

Zack Barry

Eversource

- Born in Coventry, Connecticut, and has one older brother.
- Married to his wife, Brittany. They have a one-year-old son named Luke.
- Enjoyed boating and beaching with the family, snowmobiling and four-wheeling.
- Competed at the 2023 International Lineman's Rodeo with his journeyman linemen teammates, Jimmy Rogers and Shawn Murphy.
- Currently working on pole change outs, reconductor projects, and installation of new equipment.

Zack Barry (center) competed on a journeyman team for Eversource at the 2023 International Lineman's Rodeo.

Early Years

When I was younger, I had an older friend who was a lineworker, and I always wanted to get into the trade. I did my apprenticeship with IBEW Local 42. I worked as a contractor for about seven years and came over to the power company three years ago. Every day, we do various line work tasks relating to overhead and underground distribution.

Day in the Life

I am currently a lineworker for Eversource in Connecticut., and I go out in the field every single day. The type and amount of work changes day to day. It depends on what is scheduled and ready to go. We do a lot of underground cable pulls and overhead reconductors, along with new installs and maintenance on all sorts of equipment. With the long hours we work while on storm, it can be a challenging job, but also a very rewarding one.

Safety Lesson

Job-site safety is the most important thing in this trade. Fortunately, for myself, I have not been in any major accidents, but there have certainly been times, when I thought to myself," that could have gone bad," and I have learned and grown from those.

Memorable Storm

My most memorable storm was Hurricane Irma in September 2017. I went down to Florida for two weeks with the contractor that I was working for at the time. After that trip, I went with another contractor to St. Thomas to do the restoration work from the same storm. The damage was like nothing I had seen before. The roofs were torn off homes, and properties were destroyed. As far as the grid, some of it was salvageable, while a lot of it required new pole sets and pulling in new wire. That storm was a great experience and gave me the opportunity to travel and see something different.

Tools and Technology

At the end of the day, all lineworkers are different and have to decide which tools really work for them and which ones just take up space on the truck. Personally, I don't think you can beat Milwaukee power tools in this trade. The big 7/16 impact is great to have around for tightening bolts in the air or drilling through a pole that you are climbing. The cutters are a big life saver too as you can keep one hand on an energized tap to control it, while using the Milwaukee cutters in the other hand. It seems every year new tools come out with the thought of making our job easier in mind.

Future Plans

If I had the choice, I would most definitely do this all over again. I've always enjoyed the outdoors and working with my hands. To me this is one of the coolest and most rewarding jobs you can do. As far as future plans for my career, I am not really shooting much higher than where I am at this time. I enjoy being a lineworker on a crew and getting to go out to work every day and have a good time. TDW

Editor's Note: If you are interested in being profiled in our monthly Lifeline department or know of a journeyman lineworker who would be a good candidate, email *T&D World* Field Editor Amy Fischbach at *amyfischbach@gmail.com*. To thank lineworkers for their dedication to the line trade, Milwaukee Tool sends each profiled lineworker a tool package.


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Lineworkers lined up around the hall to wait for the opportunity to enter the Lineman's Expo and discover the latest tools, technologies, products and services for the line trade.

Line Trade Unites at 2023 Rodeo Week

Lineworkers and their families connected for the most well-attended event in the Rodeo's history.

By **AMY FISCHBACH**, Field Editor

From its inception, the International Lineman's Rodeo has focused on safety and showcasing skills, and the 2023 event was no exception. Lineworkers and their loved ones traveled in record numbers to Kansas City for four full days of networking, education and competition.

The event kicked off with two concurrent training conferences—the International Lineman's Rodeo Safety and Training Conference and the Powerline Conference—at the Overland Park Convention Center. As the Powerline attendees learned about best practices for overhead wood pole design and how to safeguard line crews, the safety conference participants listened to presentations on personal protective equipment, flame-resistant clothing, situational awareness, bonding and grounding and injury prevention.

"We're here to get everybody trained up and ready and informed on things in the industry and promote the Rodeo and the safety with the Rodeo," says Rustin Owen, a member of the International Lineman's Rodeo Association (ILRA) safety committee. "It's all geared toward safety in the industry. "

Chad Schimpf, an ILRA safety committee member from Ameren Illinois, says the first day of the conference, 230 attendees registered for the event, and the second day, they had more than 300.

"It's obviously growing, and we've had a lot of good content," says Schimpf, who served as a speaker at last year's conference. "We are already looking forward to building on this year for next year "

Sharing Safety Lessons

Over the last few years, the safety and training conference opened with stories from personal injury survivors to drive home the importance of coming home safely each night. This year, the attendees listened to presentations from two arc flash survivors including Brandon Schroeder and Jason Brozen.

Schroeder shared his personal injury story called, "Believe in Safety." Back in 2000, the electrician performed a routine electrical task without his arc flash suit or proper personal protective equipment.

"It's something that I have done a million times," he says. "I went ahead and disconnected that wire, and I ended up burning 16 percent of my body."

Schroeder urged the line students, apprentices, journeyman lineworkers and field managers in the audience to take safety seriously and not take risks.

"If you take risks like I did, and have had some close calls, remember that there's someone watching you," Schroeder says. "That person may not have the skills and experience you have, and you're teaching them that the risks you're taking are acceptable. But when you have a mentality like that, it's just a matter of time before you have an accident like mine, or worse."

Journeyman Lineworker Logan Hultgren, a Rodeo competitor from Liberty Utilities, said Shroeder's presentation about his arc flash incident stood out to him at the conference.

(Left) Tim Boswell of Evergy and his team put on an electrical safety demo in the hallway outside the meeting room at the convention center. (Middle) Mike Hayward of the ILRA safety committee opened the 2023 Safety and Training Conference. (Right) Brandon Schroeder shared his personal injury story during his "Believe in Safety" presentation at the International Lineman's Safety and Training Conference.

"I'm learning about being safe, not being complacent and how to de-escalate situations," he says.

To wrap up the first day of the safety and training conference, Evergy's public safety team returned from last year to give a live electrical safety demonstration to the conference attendees. Tim Boswell and his team first talked about accidental contact between curious animals and live electricity, using the stuffed animal, "Squeaky, the Squirrel," as part of the demonstration.

The team also incinerated everything from a hot dog to a balloon. To drive home the importance of wearing flame-resistant garments, which was discussed earlier in Bulwark's Derek Sang's presentation, the team also tried to ignite a FR long-sleeved shirt, which quickly snuffed out.

"You can clearly see that it doesn't continue to burn, minimizing the damage to the soft tissue of the body," Boswell says.

Discovering New Technologies

Following the second morning of the Lineman's Safety and Training Conference, the flood gates opened to the 2023 Lineman's Expo. Thousands of lineworkers, family members and supporters lined up outside the exhibit hall in the convention center to get the first look at the latest tools, technologies, products and services for the line trade. Timothy Hanna of IBEW Local 145 came to Kansas City for Lineman's Rodeo Week to support the apprentices.

Milton Draper from Ameren Illinois and his family stopped by the T&D World booth to participate in the Line Life Podcast recording. The Expo was a family event.

"It's always good to see the vendors," Hanna says. "I just keep an eye out for new ideas, new products and things coming out on the market. There's just about anything that goes on a line truck or bucket truck. If it's out there, and it has anything to do with line work, it's here."

Joseph Herrin, who was supporting the teams from Austin Energy, says the Expo gives lineworkers the opportunity to see new power tools and other technologies on the market.

"I can see the new ideas and shoot them up to our bosses and hopefully get better equipment to help our guys out in the field," he says.

This year, the Expo expanded into a new exhibit hall space to accommodate the growing number of vendors and attendees. On the show floor, attendees could visit with exhibitors, enter drawings, participate in contests and even catch a glimpse of the KC Chiefs cheerleaders with the KC Wolf.

Swapping Shirts and Stories

After the second day of the Expo, the Rodeo Week rolled into an annual tradition: the Lineman's BBQ and Trade Night.

Everything from tiny T-shirts to hats and drinking glasses were swapped during the 2023 Lineman's Trade Night.

Before ascending the escalator for a BBQ feast, lineworkers and their families participated in a swap meet trading everything from lightning bolt earrings to caps to glasses and T-shirts. Some even offered shirts for the "little lineworkers" with tiny line trade-themed baby- and toddler-sized shirts.

Derek Wilson of Valiant Energy Service from Allentown, Pennsylvania, showcased his company's navy-blue T-shirts. His company does storm and blue-sky work in Pennsylvania and New Jersey.

"Our Rodeo logo was 'Taking Kansas by Storm' as a proud representation of our storm team," Wilson says.

Dane Olsen from OG&E says for his utility's Rodeo shirt design, they included an illustration of one of their apprentices, Drake Hirst.

"He's climbing up and out of Oklahoma and up on top of the world facing the universe," he says. "Hopefully, he's going to win this thing."

Challum County PUD out of Washington also showed its pride in the trade with a long-sleeved black T-shirt designed by Apprentice Boyd Eickmann and his wife.

"We're out of Local 997 out of Washington," he says. "We tried to capture the mountains and the water and everything we see in the Olympic Peninsula. We went with an old-time theme with some interesting letter work."

After the T-shirt swap, the lineworkers enjoyed some Jack Stack BBQ and some networking time before the day of competition at the International Lineman's Rodeo. *T&D World* also announced the winner of the raffle drawing sponsored by Milwaukee Tool. Timothy Schneider, a lineworker for Avangrid/NYSEG in New York, won a prize package valued at more than $1,000.

Following the banquet, the lineworkers and their families prepared for the 39th annual Lineman's Rodeo, which attracted competitors and spectators from around the world.

Shane Svach, general foreman for Michels Power, says it's an honor to be around so many lineworkers and their families during the Lineman's Rodeo Week. After 21 years in the trade, he now serves as a live-line trained barehander for his company, and at the Rodeo, he was judging one of the events.

"It's like a giant brotherhood coming together as one," he says. "It's a good family event to have a lot of linemen come here. I love it." TDW

AMY FISCHBACH (*amyfischbach@gmail.com*) is the Field Editor for *T&D World* magazine.

Editor's Note: You can also listen to the Rodeo-themed Line Life podcast series at *https://linelife.podbean.com/*. Part 1 features competitors and supporters, and Part 2 highlights line families and Ameren Illinois' Climbin for Kids fundraiser for St. Jude Children's Hospital. Follow the podcast on Podbean or your favorite podcasting app.

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Parting Shot

Photo by **AMY FISCHBACH**

An American flag flies over the grounds of the 2023 International Lineman's Rodeo in Bonner Springs, Kansas. Down below, the competition is in full swing with the pole climb event underway. Judges, wearing pink hard hats and high-visibility vests, prepare to judge the event, as spectators line up on the sidelines to cheer on their favorite lineworkers.


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2023 Lineman's Rodeo Roundup

A record number of lineworkers competed to be the best of the best at the International Lineman's Rodeo.

By **AMY FISCHBACH**, Field Editor

Whether it's the middle of the night or the middle of a storm, lineworkers are ready to respond. During one special week each year, however, the line trade has the opportunity to connect, collaborate and compete.

Competitor Corry Ruch traveled from Ontario, Canada, to Kansas City for the event, and she said there are three things she loves about the Rodeo: the morale, the pride and the camaraderie. Her journeyman team, including Rudy Kerec and Richard Smedley, each have about 35 years in the line trade. Over the years, they've made good friends and forged bonds with other competitors.

"We are proud and happy to be here," said Ruch, whose team placed second in the senior division in 2019.

Apprentices and journeyman lineworkers came from around the world to showcase their skills in front of their loved ones, supporters and spectators. Bryce Zahn, a fifth-step apprentice for Capital Electric Line Builders, had the opportunity to compete in front of his family, including his wife and four kids ranging from 4 to 11 years old.

"There's definitely a lot of pride involved in what we do," Zahn said. "It's neat that families can come out here and get a glimpse of the activities and the dangers of the job and see what their heroes do."

Expanding Event

The 39th International Lineman's Rodeo busted records with soaring attendance and participation. Case in point: the event had 1,316 competitors, 292 three-member journeyman teams, 541 judges, 100 volunteers and 5,328 verified registrations.

In addition, 430 learned about safety in the line trade at the International Lineman's Rodeo Safety and Training Conference, 3,100 swapped shirts and stories at the Lineman's BBQ and Trade Night and 4,721 celebrated at the awards banquet. A total of 198 exhibitors also showcased the latest tools and technologies at the Lineman's Expo, which expanded into a new hall space. In other words, it was a record year for the Rodeo across the board.

Susan Blaser, the lineman training coordinator at Metropolitan Community College-Kansas City, topped out in 1992 as a journeyman lineworker for Kansas City Power & Light (now Evergy). She said the event has grown exponentially over the last few decades. "Coming out and seeing all the changes is just unbelievable," Blaser said.

After working in the line trade for 21 years, she now helps to prepare the lineworkers of the future for careers in the line trade. During the competition, the students help the judges tie off rescue dummies for the apprentice and journeyman hurtman rescue events.

"They get to see the real world," Blaser said. "This is where I tell them you're going to come and see the best of the best. They're really excited about helping out. It gives them that pride

that they can look forward to as they go towards an apprenticeship in their future."

Uniting the Line Trade

For apprentices and journeyman lineworkers, the International Lineman's Rodeo is like the Super Bowl of competitions for the line trade. Some competitors practice year-round for the opportunity to showcase their skills at the event.

Over the years, the lineworkers have competed in typical Kansas weather that can be sunny and blazing hot one minute and drizzling, windy and cold the next. This year, the International Lineman's Rodeo kicked off to a chilly start, as an overcast sky hung over the Rodeo grounds. While lineworkers' loved ones huddled on the sidelines in blankets, the competitors slung their harnesses over their shoulders, packed up their tool carts and traveled to their first events, saying it was "perfect day for climbing."

"The weather is a little bit unfavorable, but linemen go out in all kinds of weather," said Mike Stremel, a former Rodeo competitor for Midwest Energy and now a volunteer for the International Lineman's Rodeo Association (ILRA). "I was here as a lineman myself competing for a number of years, and it's great to come back and see all the camaraderie."

Lineworkers may come together to compete to be the best of the best at the Rodeo, but at the end of the day, it's like one big family.

"If you're a lineman, you compete against each other, but the cool thing about it is they are all sharing tips and tricks that would help each other on the event," Stremel said.

Both the apprentices and the journeyman teams had to rescue a mannequin from a 40-ft pole during the hurtman rescue competitions. Erin Rowe, Endeavor Business Media

To be recognized on the awards stage, it often takes hard work and practice, says John Morrison, sub-foreman for Hydro One, which had 11 competitors including six journeymen and five apprentices, five judges, support staff and coaches. Prior to

This aerial view from a bucket truck shows the 2023 International Lineman's Rodeo in action. Erin Rowe, Endeavor Business Media

The journeyman lineworker teams had to compete in full fall protection in teams of three at the 2023 International Lineman's Rodeo. Erin Rowe, Endeavor Business Media

Lineman's Rodeo Week, the utility organized a boot camp, met as a unit and prepared for the events.

"We practiced to the best of our ability on the events that we knew about, and for the mystery ones, we'll see what happens for those," said Morrison, who was attending the International Lineman's Rodeo Week for the first time. "For the ones that we've been practicing for, we're confident that we're going to give it a good run."

He said the experience of competing before is a huge asset for the lineworkers. "Coming here for the first time can be overwhelming because it's so big. In order to win, you have to have your mind straight that you have to be quick, but it's got to be clean."

This year, all the competitors from the first-step apprentices to the members of the senior journeyman teams had to wear full fall protection, and no free climbing was allowed. According to the ILRA, this regulation will drive safety to the next level by not allowing anyone to fall off the pole. In addition, it will put everyone on a level playing field.

The apprentices didn't know the rules and regulations of the two mystery events until they arrived in Kansas City for the 2023 International Lineman's Rodeo Week. Erin Rowe, Endeavor Business Media

Michael Simmons, assistant business manager of IBEW Local 126 in Philadelphia, says his Local had two journeyman teams and five apprentices at this year's Rodeo, and he was supportive of the change.

"We went down this route in the past where some Lineman's Rodeos didn't want full fall protection, but we're out here to have fun, and someone getting hurt out here is unacceptable," Simmons said. "We're using 100 percent full fall protection in the field, and we want to use it out here as well. I think it's a great change."

Apprentices Go for the Gold

At the International Lineman's Rodeo, the competition is split into the apprentice and journeyman divisions and then further sub-divided into military, contractor, IOU, REA and MUNI. Over the last few years, the apprentices have taken their 100-point written test the day before the Rodeo, which helps to streamline and expedite events on the day of competition.

Zackery Gough, an apprentice for Pedernales Electric Cooperative, swept the apprentice division with the top score on the written test, the fastest overall time of 23:03:08 and the highest total event points of 494. To prepare for the competition, Gough spent a lot of time studying *The Lineman's & Cableman's Handbook*. "I would say practicing really helped me to build my confidence and be prepared," Gough said.

Gough, who also topped the apprentice division last year, captured more event points and finished in less time in 2023. He attributes the back-to-back win to being as smooth and precise as possible and putting in his best effort using everything he's worked on and learned.

"It's an honor to receive such a high achievement against the best of the best in the world two years in a row," Gough said. "We put in a lot of work to become the best of the best lineworkers we can be for our members and our communities, and although we don't do it for the accolades, it's nice to be recognized for our efforts."

To earn the maximum points and the least number of deductions, the apprentices had to complete the pole climb, hurtman rescue and two mystery events swiftly and safely. For the first mystery event, competitors had a drop-dead time of 15 minutes to replace a guy wrap on the span guy attachment on a 12-ft pole using a hoist, conductor grip, strap and proper hand tool with no knives. Riley Cline, an apprentice for Salt River Project, finished the event more than 19 seconds ahead of the next competitor, coming out on top.

For the second mystery event, the apprentices participated in a simulated dead and ground event to replace a bad 15-kV arrestor located on a bracket on the side of a 40-ft pole. Auston La Favor of JEA captured a win in the event with a perfect score of 100 points and a time of 3:36:00.

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Zackery Gough from PEC climbed to the top of the apprentice division with the most points, fastest time and least number of deductions. Photo courtesy of Pedernales Electric Cooperative.

During the pole climb event, apprentices all had one goal in mind—to scale the 40-ft pole safely, smoothly and professionally without breaking the raw egg.

After carefully placing the raw egg in a small bucket, and carrying it in their teeth, they had to scale the wood pole. When they reached the top, they grabbed an empty bucket on the J-hook, dropped it down to the wood chips below and placed the raw egg in their mouths. They then hung the new bucket on the hook and began their descent. Time stopped when their feet hit the ground.

Corry Ruch and her journeyman team competed in the senior division at the International Lineman's Rodeo.

Breaking, cracking or denting the egg racked up a 10-point deduction, enough to dash their hopes of getting on the awards stage. A total of 313 apprentices finished the event with a perfect score of 100 points, but only one apprentice led the pack—Derek DiCastro, an apprentice for National Grid with the fastest time of 00:44:84.

Kris Onda of CORE Electric Cooperative scored 100 points in the pole climb and finished in the top quarter of the apprentice division this year. To prepare, he and he and the other competitors from his cooperative focused on conditioning, pole climbing practice and building camaraderie. As a third-step apprentice, he is looking forward to soon competing in the journeyman division in the near future.

"We have a great journeyman team this year, and I think if we can continue building upon it and getting more experience under our belt, the less nerves we will have," Onda said. "We had a great time last year, and we're excited to knock it out this year."

Teaming Up in the Journeyman Division

Once apprentices top out as journeymen, they can compete in teams of three in the International Lineman's Rodeo. While all the journeyman teams gave it their all, one team earned the coveted "Best of the Best" trophy — the IBEW Local 47 trio of Curt Norris, Toby Claude and Brian Wheeler.

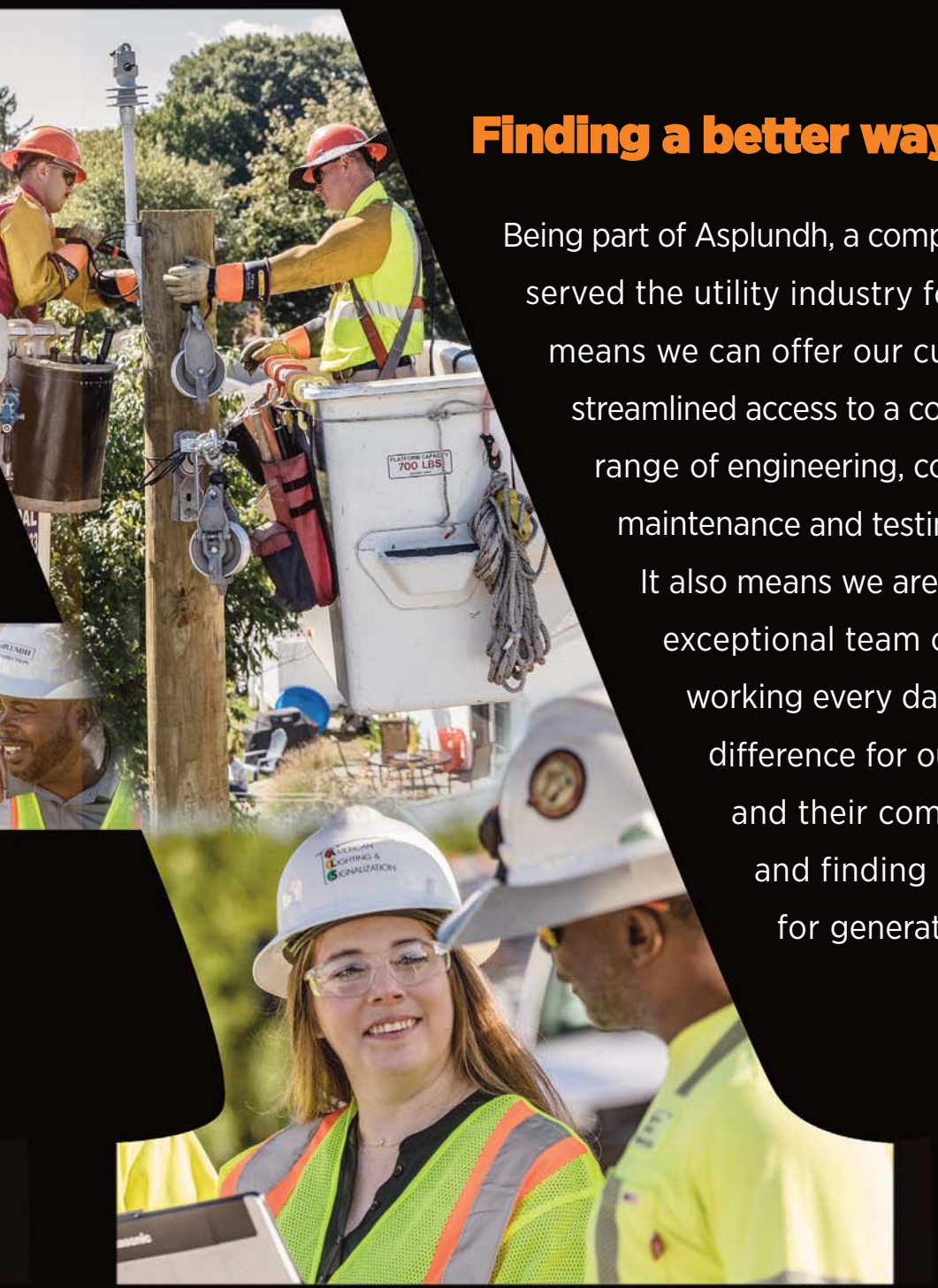
The team scored a perfect 400 points with zero deductions and completed all the events—the pole climb, hurtman rescue and two mystery events in a time of 27:11:58. As in years past, the journeyman teams didn't know the rules or regulations for the mystery events until they arrived in Kansas City and picked up their team books during Rodeo Week.

For the first mystery event, the teams used rubber gloves, blankets, line guards and other tools to replace a Brooks Braceless wood crossarm using a Hastings model 5047 temporary conductor support arm. Two journeymen climbed the pole while the third team member served as a groundman during the event. Another Local 47 team from Southern California Edison of Richard Lopez, Bryan Casas and Marcos Hernandez had a five-second lead on the nearest competitor with a time of 12:34:44.

For the second mystery event, the journeymen had to wear Class 2 rubber gloves to replace both primary jumpers while equipotential grounding. The winning journeyman team of Wheeler, Claude and Norris scored the most points in the least time for this simulated de-energized 23 kV event. Both climbers had to work as a team to replace the existing jumpers across the double dead-ends. An IBEW Local 1245/47 journeyman team also knocked out the fastest time in the journeyman pole climb with members Brandon Gloria, David Angove and Jacob Hunt.

Duke Energy's journeyman team of Miles Bell, Jordon Henderson and Heath Burrell won first place in the hurtman rescue. The Duke Energy team of Jay Tipton, Keith Griffin and Sandy Barnhill, 2022 Lineman's Rodeo champions, returned this year to place first in the senior division.

National Grid's Alex Benoit, who placed second in the apprenticeship division two years ago, also came back to the



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IBEW Local 47's Hot Line Construction Inc. team won first place in the journeyman division at the Rodeo.

International Lineman's Rodeo, but this time he was competing at the journeyman level. He competed twice as an apprentice and twice as a journeyman,

"I'm going to keep coming out here as many times as I can until, I can't," he said. "You get to meet so many different men and women who do this kind of work. That's huge."

This year, he was competing on a team with other National Grid journeymen from the same location, so they were able to get together to practice events from previous years. At the Lineman's Expo, the day before the competition, he shared his game plan.

"My plan is to get out there and give it everything I got," he said. "Hopefully, I'll walk the stage, but I want my teammates to have fun."

Tim Hanna, who was out at Lineman's Rodeo Week supporting the apprentices from IBEW Local 145, encourages others to come out and celebrate the line trade at next year's Rodeo, which will be celebrating its 40th anniversary. "The Rodeo is just really something to see," Hanna said. "You don't see that many poles and that manplace anywhere else."

Editor's Note: To listen to the Line Life Podcast episodes featuring the voices of competitors, supporters and families, visit *https://linelife.podbean.com*. You can also view photo galleries and videos from the event on our website at *tdworld.com/electric-utility-operations*.

AMY FISCHBACH (*amyfischbach@gmail.com*) is the Field Editor for *T&D World* magazine.

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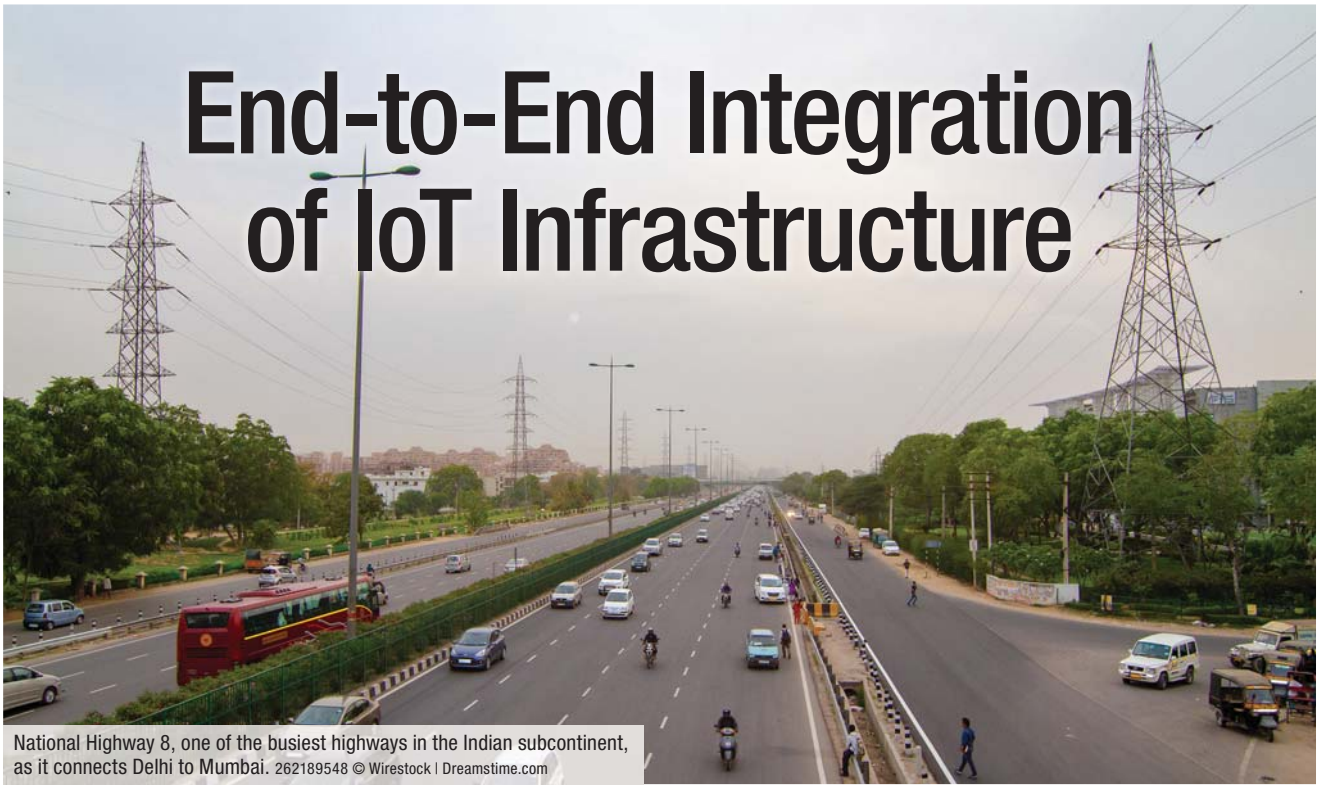
End-to-End Integration of IoT Infrastructure



National Highway 8, one of the busiest highways in the Indian subcontinent, as it connects Delhi to Mumbai. 262189548 © Wirestock | Dreamstime.com

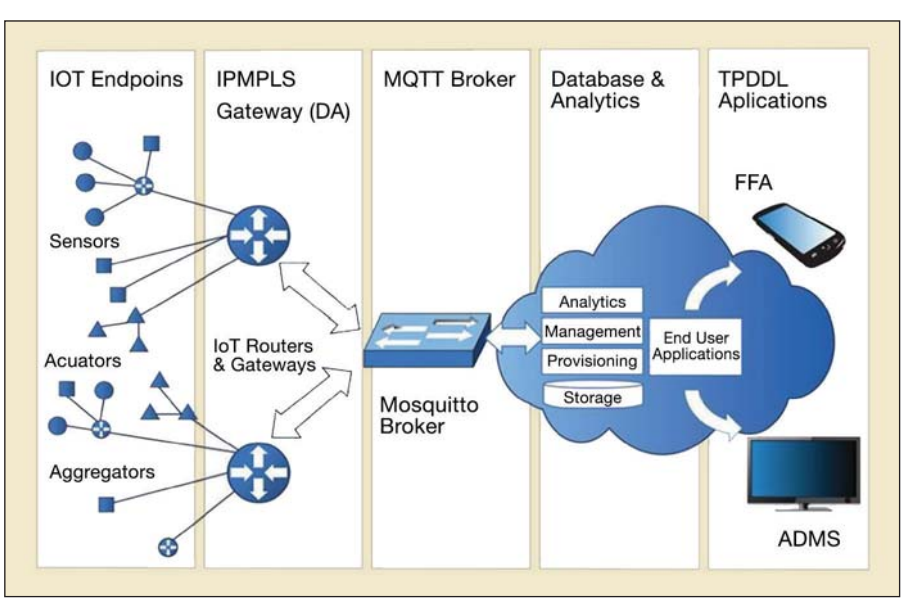
Tata Power DDL uses IoT-based automation technology to digitalize its low-voltage grid.

By **SHRINJOY BAGCHI** and **H.C. SHARMA**, Tata Power Delhi Distribution Ltd.

Tata Power Delhi Distribution Ltd. is a joint venture between Tata Power, with 51% ownership, and the Government of National Capital Territory of Delhi, with 49%. Since its inception in 2002, the organization has implemented groundbreaking technologies such as an advanced distribution management system, an integrated geographic information system, advanced metering infrastructure, automated demand response, a smart streetlight management system, field force automation, distribution network upgrades and a smart billing system. As a result of these improvements over the last 21 years, the overall aggregate technical and commercial losses were reduced from 53% in 2002 to 6.39% in 2023, and the system availability index improved from 70% to 99.9%, respectively.

Low-voltage distribution can be a significant challenge for electric utilities. Generally, most technology has been implemented on high-voltage and extra-high-voltage networks. On the contrary, most customers are connected to low-voltage networks. At Tata Power Delhi Distribution Ltd. (DDL), the sub-transmission network is completely automated and 25% of substations in the 11-kV primary distribution network are fully automated. However, the low-voltage network lacked automation.

With the proliferation of rooftop solar, the power flow in the low-voltage network is now bidirectional, a significant challenge for operational safety. Utilities must be equipped with robust technologies to measure and monitor power flow and power quality on the low-voltage network. At the same time,



End-to-end integration of IoT infrastructure.

they should prepare a specific action plan to improve power quality, reduce technical losses and enhance network safety. As part of its action plan, Tata Power DDL implemented state-of-the-art IoT-based automation to operate and efficiently manage the low-voltage distribution network in the northern and northwestern parts of Delhi.

IoT Automation

With 24,772 distribution feeders, Tata Power DDL's low-voltage network is around 6750 circuit km long — and continues to grow annually. Because its network lacked automation, the utility did not receive any firsthand information before, during or after power outages. It only knew an outage occurred when a customer called in to report one. The total number of complaints on the low-voltage side — stemming from low-voltage circuit-breaker tripping — increased by 57% in fiscal year 2017-2018 compared with the year prior, and the average supply restoration time was as high as 66.86 minutes.

To implement IoT automation through an end-to-end architecture, Tata Power DDL first identified the critical substations based on certain conditions. Some criteria were weighted more heavily, such as feeders with a high number of customers connected, frequent tripping feeders, substations in heavy traffic patches, feeders with high fault restoration times, feeders affected by high transient faults and those with a high volume of complaints.

Each IoT edge device was designed to monitor the digital status of all isolators, breakers, fault passage indicator and gas pressure sensors of one four way ring main unit. The devices also communicate with a minimum of four Modbus relays. In addition, they monitor the temperature of the transformer bushing and send an alert when a hot spot is created in any phase. The devices also measure the daily peak load and current harmonics of all outgoing low-voltage feeders as well as the active, reactive and apparent power of distribution transformers.

End-To-End Integration

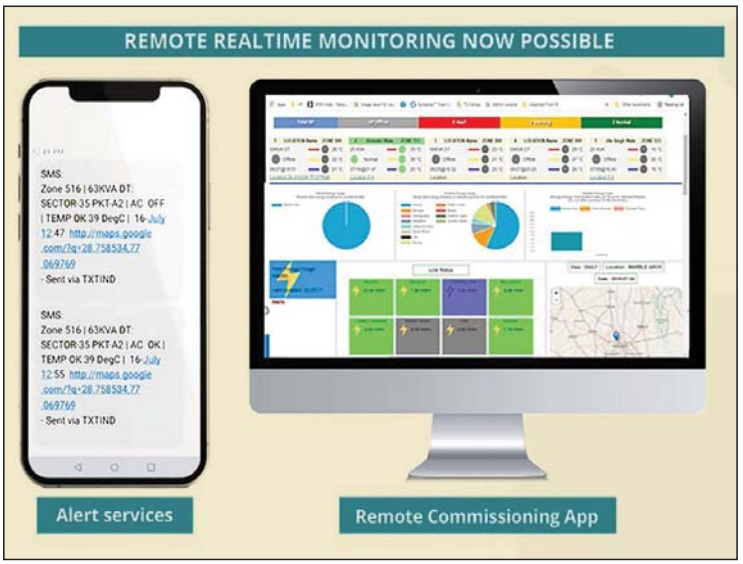
Eight separate digital inputs on each of the devices monitor medium-voltage breaker status, ring main unit SF6 leakage issues and the status of the fault passage indicator. IoT device integration is governed by the state of the information technology-operational technology (IT-OT) integration at Tata Power DDL. The IoT devices communicate using the secure MQTT messaging protocol with the broker, and the broker is further connected with the database and application servers. The communication infrastructure is on the 4G multiprotocol label switching network.

The IoT application server is integrated with the ADMS to share outage information with the central supervisory control and data acquisition system. The ADMS servers are integrated with the field force automation system and SAP IS-U customer care center. When an outage is reported at the site, the IoT device alerts the IoT application server through broker services over the secure wireless medium. The IoT application server then sends the information to the ADMS system.

Low-voltage IoT device installed in outdoor substation. Photo by Tata Power.

Once an outage is created in ADMS, the information triggers the SAP IS-U application. The nearest field crew receives real-time updates about the breakdown. In addition, the call center uses the information to update customers about the outage and expected supply restoration time. After power is restored, the IoT device sends closing information to the IoT applications. The IoT applications send this information to the ADMS, FFA and SAP IS-U applications. As a result, outage jobs get closed through an automatic chain, and no manual intervention is required.

Field installation of low-voltage IoT devices. Photos by Tata Power.



Low-voltage IoT dashboard and SMS services.

Analytical information such as current, voltage, energy (active and reactive) and peak loading data is captured in the IoT back-end application for further analysis by the reliability team.

Inspiring Results

The end-to-end IoT infrastructure has been implemented in more than 300 substations containing 1589 low-voltage breakers, 481 ring main units, 400 distribution transformers, 481 fault passage indicators and 121 relays. Around 318,000 customers are supported by IoT devices. The outcome of this large-scale implementation has been multidimensional and inspiring. The project kicked off in December 2020 and was fully implemented by March 2022.

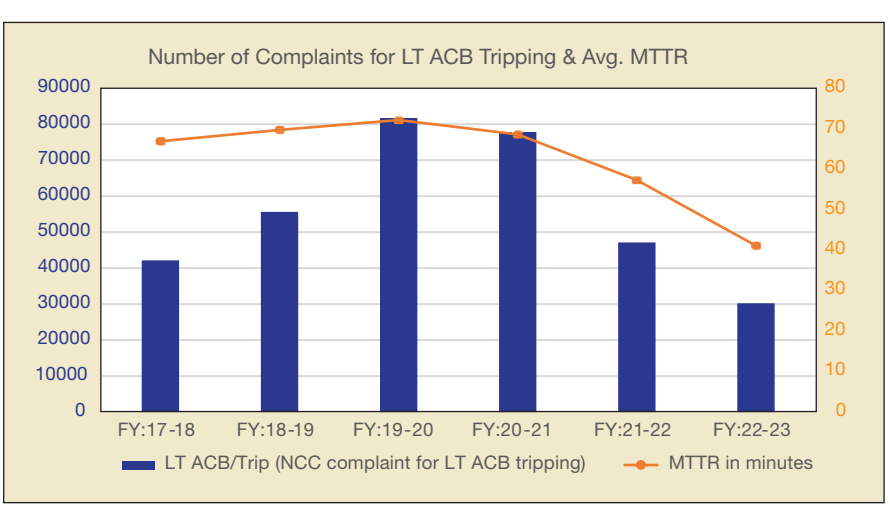
Prior to the implementation, the total number of customer complaints stemming from low-voltage circuit-breaker tripping had been on the rise, increasing from 31% in fiscal year 2019 to 46% in fiscal year 2020. After implementation, complaints decreased gradually by 4.77%, 39.44% and 35.85% in fiscal years 2020-2021, 2021-2022 and 2022-2023, respectively. Integration of the real-time tripping information helps field crews to restore faults more quickly. The low-voltage IoT sends parallel information to the crew by directly triggering an SMS text when an outage has occurred as well as through the ADMS integration. As a result, the minimum-time-to-restore low-voltage breakdown was reduced from 19.72% in fiscal year 2021-2022 and 28.09 % in 2022-2023.

Maintenance and network enhancement plans are now designed based on tripping events, load profiles and the energy profiles of individual feeders captured on the IoT dashboard. The regional team takes corrective actions on the network based on the tripping statistics captured.

To reduce technical losses, unbalanced feeders are balanced by shifting the load to less loaded phases. To date, corrective action has been taken on 582 low-voltage feeders. Capital expenditure planning also is optimized to identify underloaded low-voltage feeders, and additional load shifting also is performed on light-loaded feeders from overloaded feeders.

The multidimensional benefits of the low-voltage IoT application have inspired Tata Power DDL to scale up the project and extend its benefits to another 640,000 customers in northern and northwestern Delhi. Real-time power factor measurement of distribution transformers, energy auditing data and current harmonic measurement of low-voltage feeders also have made it possible for the utility to analyze customer load profile, energy pilferage, power-quality issues and reactive power issues in the low-voltage network.

IoT-based low-voltage automation technology is robust, compatible with any kind of air circuit breaker and easily deployable. Other utilities in urban areas could benefit from this technology to effectively digitalize their low-voltage grids. TDW



Overview of complaint and minimum-time-of-supply restoration by year.

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PowerSouth Energy @ powersouth

Students from Opp Elementary recently toured a power plant to learn how electricity is generated!

Palo Alto Utilities @ PAUtilities

Today, the Peninsula Conservation Center said goodbye to natural gas! Mayor Lydia Kou and Utilities staff shut off the gas service for the building.

ITC Holdings Corp. @ITCGrid

At ITC, we have a "find it, fix-it" mentality. If some deficiency is found – fix it, so it doesn't become a bigger problem later. Our comprehensive maintenance programs help bring quantifiable increases in transmission system reliability.

Eversource Energy @ EversourceCorp

Sailing away from the Port of New London last night, @SouthForkWind's first turbine is headed to the lease area to be installed! The New London State Pier will continue to be buzzing with activity as we work on *#BuildingSouthFork.*

Avista Utilities @ AvistaUtilities

An early morning view of our historic Post Street Substation.
📸: @JamesARichman

NV Energy

🎉 Today, NV Energy joined the Regional Transportation Commission of Southern Nevada and Nevada Conservation League to launch new battery electric buses, supported through an NV Energy grant! 🚌 This is a great step forward to help reduce the community's emissions footprint and NV Energy is a proud partner in this work.

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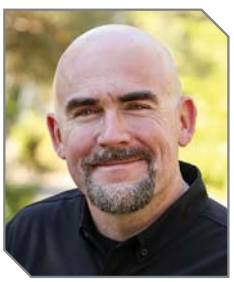
Setting Sights on Decarbonization and Electrification Goals



California leaders are pioneers when it comes to enacting policies to help realize a better future for their citizens. For California utilities, answering this call to action is no easy feat. Before setting into motion any grand plans, they must conduct an expert analysis to know where they need to be before the goal date of 2045.

No greater example exists of this type of in-depth analysis and future projections than that of Edison International's *Countdown to 2045* white paper, published in September 2023. This paper considers policy adjustments, climate influences, market and technological advancements, and a reliability analysis of the electric sector. It provides an understanding of how increased electrification — fed by clean generation and made available by great expansion of the electric grid — is required to meet the decarbonization goals while upholding grid reliability and customer affordability.

According to *Countdown to 2045*, three times the current capacity of utility-scale clean energy resources will exist by 2045, primarily derived from new solar, wind and energy storage. In this future scenario, 90% of vehicles and 95% of buildings will rely on electricity, leading to an 80% surge in demand. Achieving this transformation calls for immediate and fundamental changes in how the state plans and operates its entire energy infrastructure. State agencies and utilities must accelerate grid expansion, incorporating new transmission and distribution grid projects at rates up to four times and 10 times their historical averages, respectively.

To meet California's ambitious objectives, utilities must explore a range of possibilities, including greater integration of emerging technologies like carbon capture, to identify the most practical solutions. A similar overhaul is essential on a global scale to meaningfully curb climate change by reducing greenhouse gas emissions. These investments will not only contribute to cleaner air but also open avenues for economic growth. While electricity bills may increase, the savings from reduced fossil fuel expenses are expected to more than compensate for them.

Expected Increases

This projected scale-up to the SCE service territory means projected load growth requires an acceleration in grid expansion. Over the next 10 years, the California Public Utility Commission's integrated resource plan aims to add 7 GW/year, which will drive the California Independent System Operator's planning for transmission expansion. In the following decade, the pace of capacity expansion must increase to about 8 GW/year, on average, until 2045. California's transmission system buildout must keep pace with system-wide resource capacity growth.

Today, CAISO has 26,000 transmission circuit miles. To interconnect 120 GW of new resources, tripling bulk resource capacity, at least 20,000 circuit miles of 500-kV transmission must be added. Deployment will need an investment of about US$75 billion to interconnect CAISO resources, import out-of-state resources and bolster the sub-transmission grid. Providing electricity customers with 80% more energy in 2045 also requires the distribution system to expand significantly while simultaneously increasing the throughput and average use of the thousands of circuits already in use today.

The equivalent of 85 new distribution substations will be needed. Also, 350 of SCE's approximately 900 existing substations will need to be upgraded to expand their capacity. More than 1400 new distribution circuits will be required, which is about 30% more circuits than SCE has in operation today.

Readying The Front Line

Given this upcoming increased workflow culminating to 2045, what are some of the top considerations? For starters, system growth is not possible without equipment and materials, and lead times are greatly increasing for essential components such as high-voltage transformers and circuit breakers. For instance, reports of lead times for new high-voltage circuit breakers extending out from three years to an unprecedented five years from the date of purchase order issuance, and transformers are following suit. This requires system planning organizations to move quickly and efficiently from forecasted needs to actual project plans, with material orders placed decisively in record time.

Utilities can benefit from greater supplier diversity. They start by updating their design standards and specifications to provide more material options for engineering and procurement teams to work with. Often, a top limitation is material availability, a constraint that can be relieved by updating asset engineering standards, diversifying the list of available material and design options, and by trying out new equipment and new suppliers.

As far as resource and workforce planning, services will be in high demand starting from initial project design and engineering to field crews. Developing and growing contract workforces will be key as internal and external resource limitations highlight bottlenecks that can quickly be solved for by the contract option, provided new contractor resources are located and prequalified. A most valuable consideration here is to maintain an effective competitive bid process that provides healthy market competition and keeps project affordability front and center during the procurement process.

Regardless of a state's political environment, there is no denying that transportation and other markets will become electrified, and this requires great leadership. The state of California, Edison International and SCE are up to the task. TDW

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