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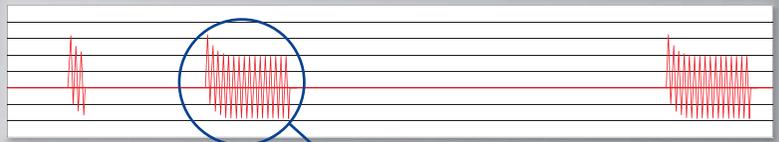
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Screen shot of typical recloser closing into a fault



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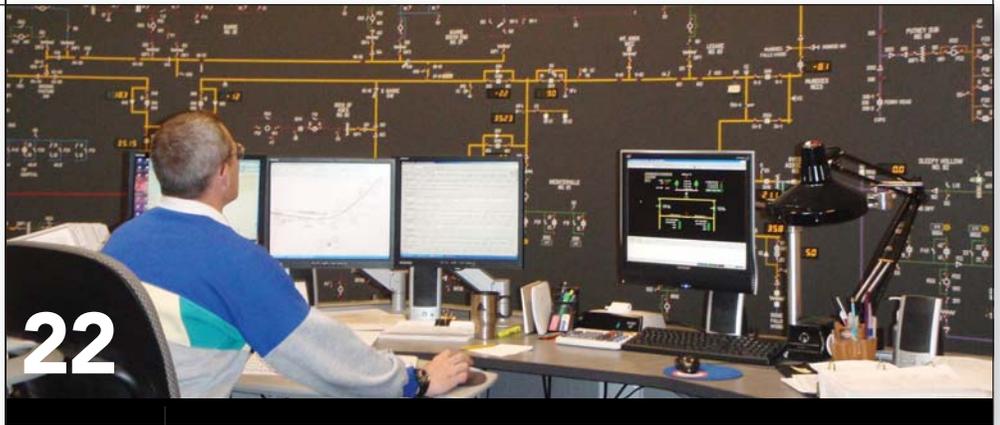
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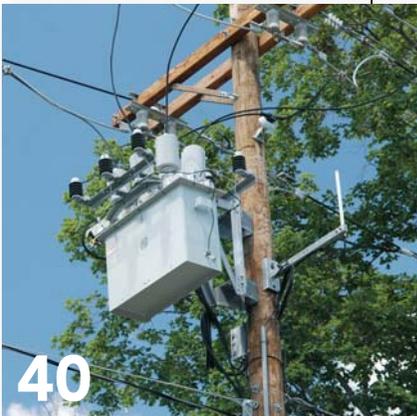
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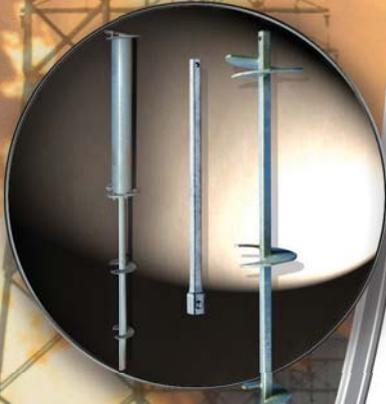
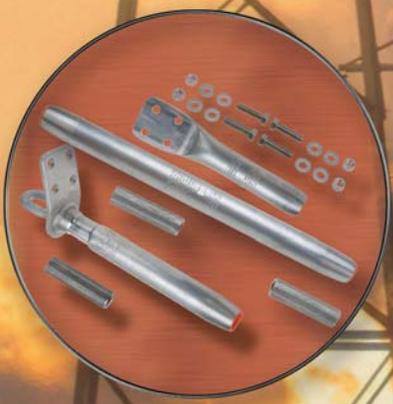
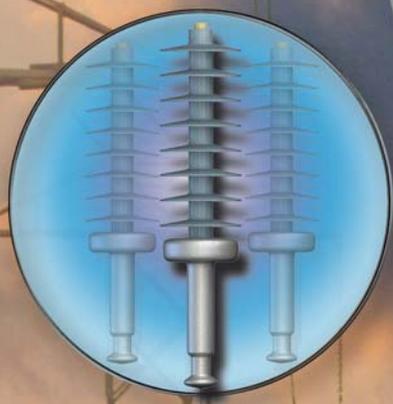


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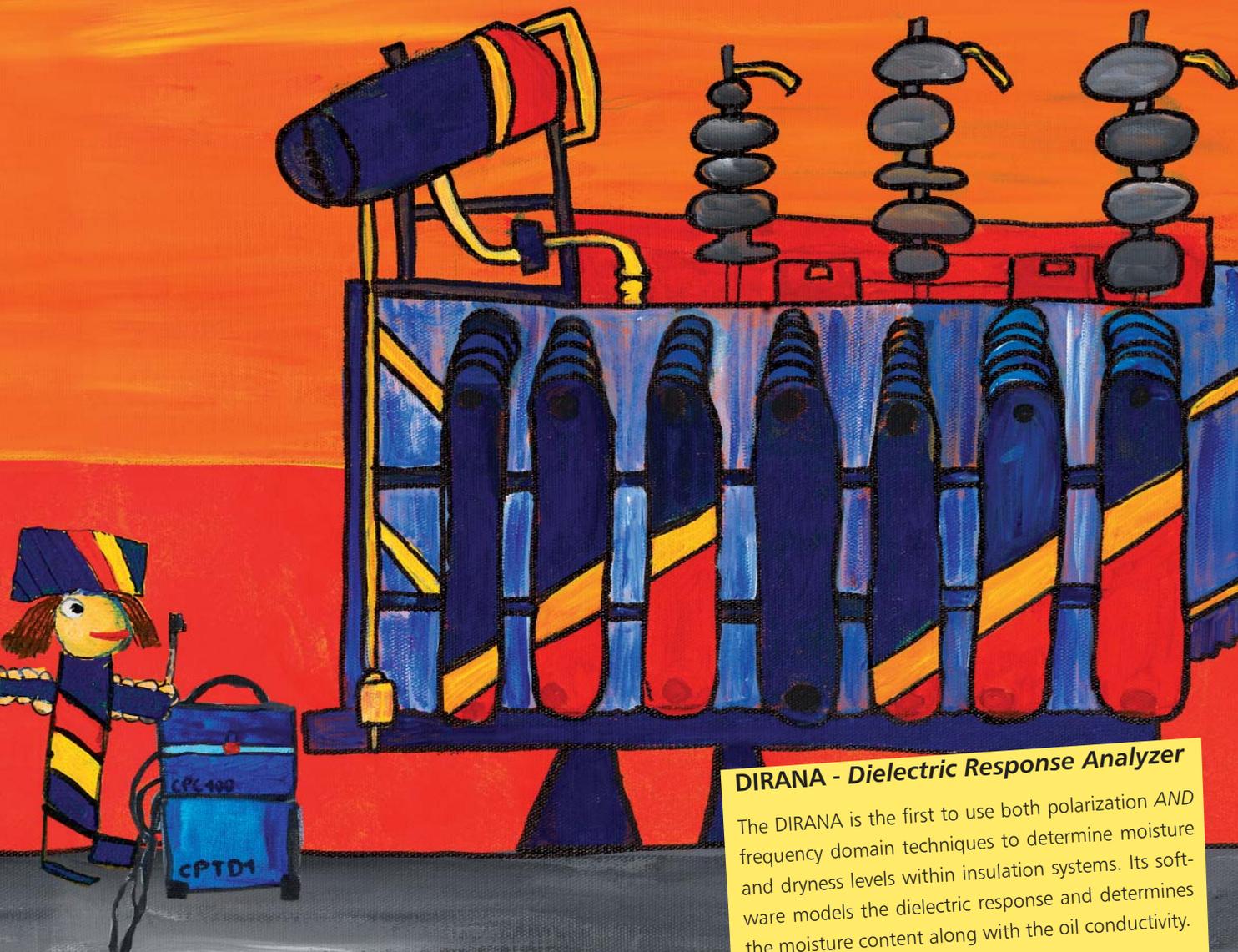
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The Invention of @Uncle_Vito

EARLY WEB SITES WERE STATIC AND CONTENT WAS CAREFULLY MANAGED. But, somewhere in the early 2000s, events conspired and technology enabled all heck to break loose. True broadband communications became accessible to everyone, and blogging established a more participatory Web model. Close on the heels of this were the various components of what has today become collectively known as *social media*, which is arguably one of the most chaotic components of what we know and love as the World Wide Web.

I AM A TWIT

In April, I decided to try Twitter to see if it was possible to provide another dimension of value and relevance to the *T&D World* audience. Okay, and have a little fun in the process.

Among the immediate challenges was coming up with a Twitter name. I was amazed at the variations of Vito I found, including @VitoTheGuideDog!, @GodFather and @DonVito. When I first joined the *T&D World* staff, Doug Fix called me Uncle Vito. Years later, that seemed like a good handle. Since @UncleVito already belongs to a radio personality in upstate New York, I am @Uncle_Vito.

ALL THE WORLD'S A TWEET

Tweeting is so undefined that just about anything fits. It seemed like using Twitter to promote the editorial content of *T&D World* would be a natural. But, how dry is the title of a feature article? So, with a little creativity — goodness knows from where these “inspirations” come — I got haiku tweets:



Uncle_Vito goes #haiku over July story STRATEGY FOR NEW EFFICIENCY STANDARDS - DOE standards / dictate transformer efficiency / ComEd and PECO ready
about 15 hours ago from HootSuite

Okay, it may be a sloppy haiku, but you get the idea. I also notice the MOST READ box on www.tdworld.com. And, a side feature of Twitter pages is trending topics — words that most frequently show up in tweets. Mash those two things together in a technology editor's mind, and it makes perfect sense to tweet about www.tdworld.com content that is MOST READ.



Uncle_Vito sees Siemens builds the largest (40MW) cast resin transformer. Very interesting story. <http://ow.ly/he0s>
6:31 AM Jul 14th from HootSuite

That weird URL is a compression of the long URL to the article. An invention required to meet the 140-character maximum tweet length. I'm figuring that if it was interesting to me, then there is likely some twitterati out there who'll find it interesting. People will read 140 characters about most anything. And, if they want more, there is always the link.



Uncle_Vito Quite Cool!! RT @MEAenergy Patty Walker of Duke Energy is Awarded Energetic Women's Maverick Award
<http://tinyurl.com/i7pgry>
8:15 AM Jul 8th from web

RT is a re-tweet. This tweet from @MEAenergy went to all of their followers, of which I am one. Then I blasted it out to my followers. There is a viral component to social media. It also seemed like a good idea to tweet about the various industry events that we attend.



Uncle_Vito #ets09 pre-conference foundation workshop by Dr. A.M. (Tony) DiGioia on 11/8. Should be very worth while.
<http://ow.ly/gjE1>
about 24 hours ago from web



Uncle_Vito to be at #ets09 - ASCE Electrical Transmission & Substation (ets) Structural Conference 11/8-12, Fort Worth
<http://ow.ly/gjE1>
1 day ago from web

Regular news items or press releases that come across my desk get tweeted, too. Sometimes I'll come up with my version of a pithy observations to squirt out.



Uncle_Vito likes it that people might make the connection between transmission lines and the need to deliver this green energy =)
7:46 AM Jul 9th from HootSuite

This is getting perilously close to having fun, but it's also making my job easier. What has surprised me is how useful the connections with my followers and the folks I follow have become during this relatively short time. Swapping tweets in a “conversation” with another tweet has been quite useful on multiple occasions and helpful in securing article leads. Realizing that this is not a one-way thing is seminal. Further, the ability to get connected to people I'd never otherwise come upon has been very useful.

The person who springs to mind is Trish Freshwater, a public affairs coordinator at SCANA Corp. She covers a broad range of topics in her tweets. She is observant about the use of social media in ways I'd likely never imagine. She says: “The interesting thing is that our entire department is on Facebook,



TrishFreshwater If you're eating a hot dog for lunch, moment of silence please. Oscar Mayer dies at 95. <http://bit.ly/aWGH2> via @stephskordas @Mediabistro
10:34 AM Jul 8th from TweetDeck

and social media has become an extension of our office from water-cooler chatter to helping each other on assignments. It's fascinating to be part of this time of emerging media and watching the paths we're wandering down.”

If you are on Twitter, give @Uncle_Vito a try. If you are not, get with the program. TDW

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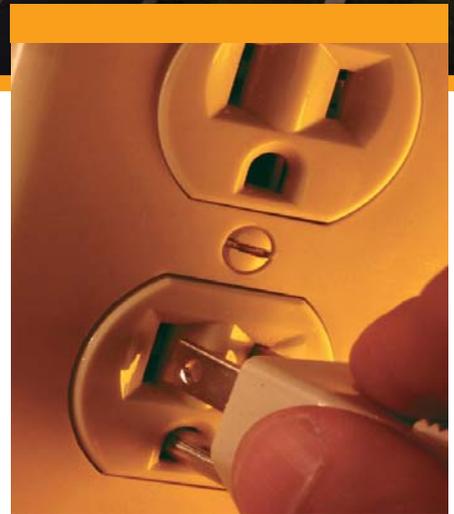
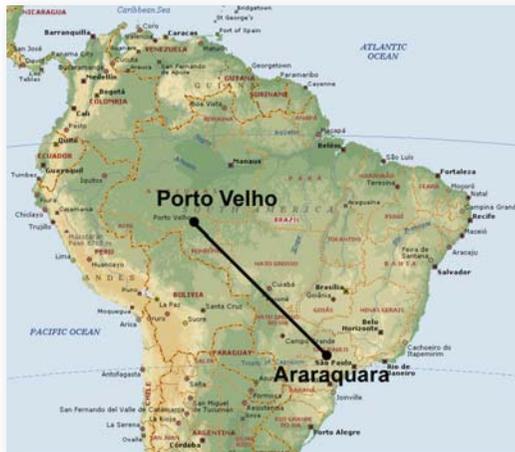


ABB to Supply HVDC Technology to Minimize Transmission Losses Across 2500-km Power Link

ABB (www.abb.com) has won orders worth more than US\$540 million from the Abengoa Group (www.abengoa.com) to deliver the key technology for the world's longest power transmission link to be constructed in Brazil.

The power highway will link two new hydropower plants in the northwest region of the country with São Paulo, Brazil's main economic center, over a distance of 2500 km (1553 miles). Power will be transmitted at very high-voltage (600 kV) to minimize transmission losses.

This will be the second transmission project in Brazil using high-voltage direct current (HVDC) at 600 kV. The Itaipu project, with two transmission lines built by ABB in 1984 and 1987, is the world's highest-



Rio Madeira will be the longest HVDC link built to date.

voltage DC power transmission system currently in operation.

ABB will provide two 3150-MW HVDC converter stations, and an 800-MW HVDC back-to-back station to transmit power to São Paulo and the AC network in the northwest region of the country. The stations, scheduled for completion in 2012, are a part of the government's Program to Accelerate Development.

HVDC has lower losses and a smaller footprint than traditional AC transmission systems, and is able to stabilize intermittent power supplies that might otherwise disrupt

the grid. For these reasons, it is the technology of choice for long-distance transmission projects that can deliver electricity from remote generation sources to where it is needed.

Ofgem Says Electric Companies Must Spend £6.5 Billion to Upgrade Network

Ofgem has ruled that electricity companies must spend £6.5 billion on upgrading the network into a low-carbon Smart Grid. The move will add £4 to household monthly bills over five years.

The energy regulator told the companies that they must deliver service improvements for 17% less than the amount that they had asked to spend. Britain's 14 electricity networks — owned by companies such as E.on, Iberdrola, Scottish & Southern Energy and Warren Buffett's MidAmerican Energy Holdings — will need to cut operating costs by about 10%.

Ofgem said that this will prevent "unnecessary price rises in today's difficult economic environment." Currently, about £67 per year in household bills is already spent on upkeep of the network.

Part of the price rises will relate to building Smart Grids, enabling consumers to sell electricity generated by solar panels or wind turbines to the national network. The rest of the money will be spent on ensuring that the companies are investing in a low-carbon future. Britain's electricity network was largely built in the 1950s and is now in need of upgrades.

Alistair Buchanan, Ofgem's chief executive, said: "Our electricity network proposals are tough but fair and will deliver for energy consumers today and in the future. We have accepted the companies' investment plans but told them to deliver them at much lower cost."

Ofgem's proposals come as the Energy Retail Association (ERA) — which represents the major gas and electricity suppliers — called on the government to turn its commitment to smart meters into "firm policy decisions and clear action."

The ERA's research revealed that almost two-thirds of people had not heard of the devices that measure energy use in the home, despite the government's recent announcement that the meters would be in every home by the end of the next decade.

ITC Great Plains Positioned to Move Forward with V-Plan

Reliable, renewable electricity in Kansas is now a step closer to reality thanks to a recent state decision that clears the way for ITC Great Plains, LLC (Topeka, Kansas, U.S.) to continue pursuing construction, ownership and operation of the extra-high-voltage V-Plan transmission project.

The Kansas Corporation Commission (KCC) ruled on July 24 that ITC Great Plains can construct and own two sections of this important 765-kV project. The KCC ruling also gave approval to Prairie Wind Transmission, LLC to construct and own a third section of this 180-mile (290-km)-long line.

ITC Great Plains, in collaboration with Sunflower Electric Power Corp. and Mid-Kansas Electric Co., will now seek other regulatory approvals required to move the project forward, including project evaluation and cost-allocation resolution by the Southwest Power Pool regional planning authority and siting permission from the KCC.



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125 Switchgear & Controlgear Equipments	60 Industrial Controls & Automation Systems	42 Design & Consultancy
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BUSINESS Developments

The V-Plan is the largest electric infrastructure investment proposed in Kansas in nearly 25 years.

In addition to improving electric reliability and facilitating wind energy in Kansas, the V-Plan will establish a critical east-west transmission corridor across the state. ITC Great Plains estimates it will invest approximately US\$400 million to construct its portions of the project at 765 kV.

The KCC's July 24 decision accepted a Stipulation and Agreement (S&A) reached between ITC Great Plains and Prairie Wind that set forth which sections of the line each company would construct and own. Under the terms of the

S&A, ITC Great Plains will construct and own segments of the line running from Spearville to Comanche County, Kansas, and from Comanche County to Medicine Lodge, Kansas. ITC Great Plains will also construct and own new substations in Comanche County, Spearville and Medicine Lodge.

Prairie Wind will construct a substation at Medicine Lodge and a third section of line from that substation to a termination point outside of Wichita. Prairie Wind also would be certificated to construct a line from the Kansas V-Plan to the Oklahoma border. The settlement agreement addresses only facilities proposed to be constructed in Kansas.

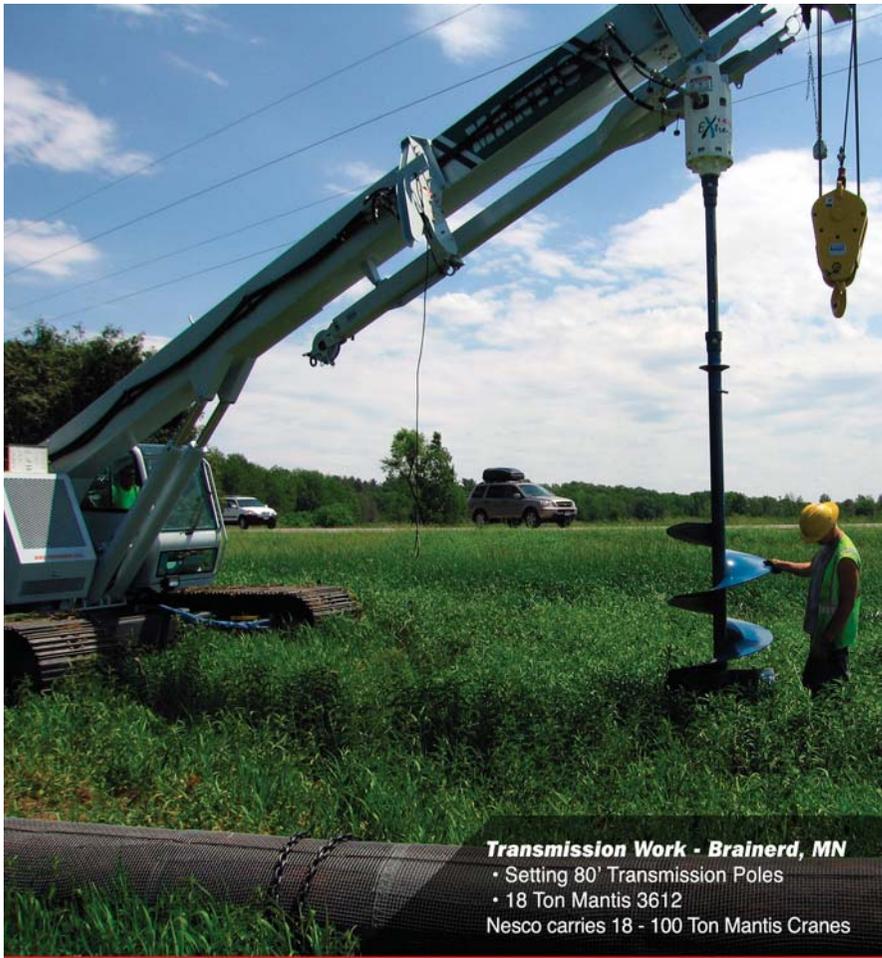
Santa Clara Issues RFP for SVP Meter Connect Program

Silicon Valley Power (SVP; Santa Clara, California, U.S.), the city of Santa Clara's municipal electric utility, has issued a request for proposals (RFP) from suppliers interested in providing an advanced metering infrastructure solution built upon a robust IP-based utility communications infrastructure. The system will provide a foundation for SVP's new SVP Meter Connect program, serving the 51,000 residential and commercial customers of SVP.

The city intends to upgrade its existing utility communication and IT infrastructure(s) to create a working Smart Grid as it is conceived today, and to build a strong, flexible and scalable foundation for the Smart Grid of the future.

At the same time, the city seeks a multifunctional communication system to support a fast-growing demand for wireless IP-based narrowband and broadband applications for a diverse group of city departments. Existing infrastructure includes an extensive local fiber-optic network, and a wireless network supporting free outdoor Wi-Fi service to most residential areas of the city.

Siemens Energy Corp. has been selected to implement eMeter's meter data management solution called EnergyIP for managing the increased amount of data collected by this AMI solution. The city anticipates implementation of this new system in phases beginning in the fourth quarter of 2009. TDW



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Wayne Preston
Construction Manager, Otter Tail Power Company

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AMSC Receives Second D-VAR Order for Chinese Power Grid

American Superconductor Corp. (www.amscc.com) has received its second order for a D-VAR system to meet dynamic reactive compensation requirements for the Chinese power grid. China National Machinery Industry Complete Engineering Corp. (CMCEC; Beijing, China) will deploy the D-VAR system to meet local grid interconnection requirements for Phase I of the Guanting Wind Farm, located in the Beijing area.

AMSC also announced that CMCEC has been named as the company's second channel partner for sales into China's power grid market. CMCEC is a large state-owned enterprise, involved primarily in project contracting, import and export trade, and energy and environmental protection. CMCEC will install the D-VAR system in a 110-kV electrical substation operated by the Beijing Energy Investment Holding Co. Ltd. (Jingneng Group).

"China's wind power market continues to grow very rapidly," said Bai Sun, president of CMCEC. "This rapid growth has created a strong demand for grid interconnection solutions for wind farms. As a state-owned enterprise, it is our responsibility to facilitate the continued growth of China's wind industry to reduce CO₂ emissions, while at the same time ensuring that the power grid is functioning reliably."

Once all phases are complete, the Guanting Wind Farm will provide 150 MW of wind power generation for the local grid. The Beijing Electric Power Design Institute (BEPDI), a division of China's State Grid Corp. responsible for transmission and distribution engineering, determined that the wind farm required dynamic reactive compensation. BEPDI was also involved in the design of the wind farm project.

AMSC customers use D-VAR solutions to provide voltage regulation and power factor correction, along with post-contingency assistance to stabilize voltage, relieve power grid congestion, improve electrical efficiency, and prevent blackouts in power grids.

POWER Engineers to Design Major Transmission Upgrades in Nebraska

POWER Engineers (www.powereng.com) has started work on a series of transmission upgrade projects for Nebraska Public Power District (NPPD; Columbus, Nebraska, U.S.), with an estimated engineering price tag of approximately US\$23.3 million and a projected construction cost of approximately \$200 million.

NPPD plans to build more than 140 miles (225 km) of 345-kV and 115-kV transmission lines in locations around the state to connect new crude oil pumping stations, interconnect proposed wind farms and continue to maintain reliability in NPPD's system.

The projects include two 115-kV transmission lines totaling approximately 15 miles (24 km) to continue to provide system reliability and support economic growth in South Sioux City, Nebraska; the 40-mile (64-km) Nebraska portion of an 185-mile (298-km) 345-kV transmission line running between Axtell, Nebraska, and Spearville, Kansas, to strengthen the regional 345-kV transmission grid; 70 miles (113 km) of 115-kV transmission lines in various locations in central and north-central Nebraska to power a series of new crude oil pumping stations associated with the TransCanada Keystone XL crude oil pipeline; and approximately 15 miles of 115-kV transmission line to support proposed wind farms in Nebraska.

NPPD selected POWER Engineers to provide routing, surveying, permitting, engineering, right-of-way acquisition and construction management, which are scheduled to be completed by summer of 2012.

Pepco Holdings Inc. (PHI; Washington, D.C.) will deploy software from Aclara (www.aclara.com), part of the Utility Solutions Group of ESCO Technologies Inc., to help its customers understand how they are using energy as well as how their usage affects the environment. The utility will employ Aclara's load and rates analysis and carbon-footprint calculator modules to allow customers to view data about their electric and gas usage, as well as to calculate their carbon footprints.

PHI will implement the load and rates analysis module in 2009 to its Delmarva Power service area in Delaware, but plans to extend the module to all of its 1.9 million customers by 2013. The carbon-footprint module will be available for all PHI customers immediately.

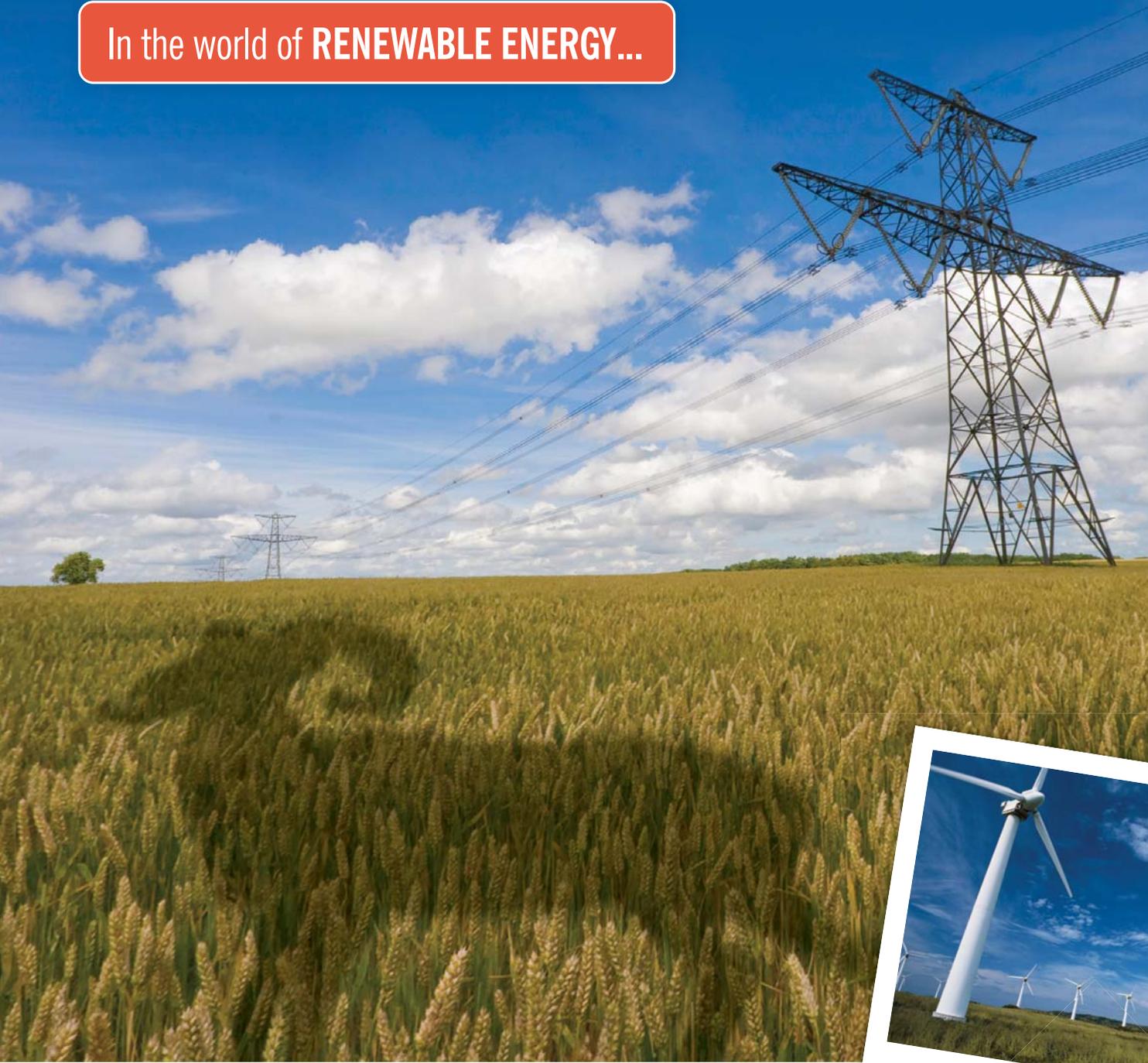
The load and rates analysis module provides charts that illustrate hourly and daily electric and gas use. The module takes into account attributes such as weather, average usage, weekend versus weekday usage, and on-peak or off-peak time periods. In addition, the module offers a rate-comparison calculator that allows customers to perform what-if analysis on various alternatives such as time-of-use rates. It also will estimate a customer's bill at any time in the month based on the last bill and current data from the advanced metering infrastructure system.

The carbon-footprint calculator determines the environmental impact of customers' usage using data they input into the system about energy, water, transportation and waste.

Both modules help educate customers, supplying the information they need to take action to reduce their bills.

The new software also will benefit customer-service representatives, who will have access to information about individual customer's gas and electric usage during billing calls. The information will help them consistently explain billing fluctuations to customers and identify strategies to lower their bills.

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NV Energy Selects OSI for EMS and DMS

Open Systems International Inc. (www.osii.com) has been awarded a comprehensive new contract by NV Energy Inc. (NVE; Las Vegas, Nevada, U.S.) to supply next-generation SCADA and energy management platforms for its two Nevada subsidiaries, Sierra Pacific Power Co. in Reno and Nevada Power Co. in Las Vegas.

In anticipation of the One Nevada Transmission Line project, a 230-mile (370-km) 500-kV north-south AC transmission line set to interconnect the transmission systems of NV Energy's subsidiaries in northern and southern Nevada, NVE has embarked on a system modernization project, choosing OSI to upgrade and enhance its energy management and control infrastructure, replacing and consolidating two existing legacy energy management systems. NVE is planning to retain T&D operation for both utilities in their respective locations, while providing balancing authority EMS functions for the consolidated transmission network in its Reno location.

SEL Announces Intuitive Solutions for Grid Security

As the utility industry continues to make the electric power grid smarter and less vulnerable to attack, Schweitzer Engineering Laboratories Inc. (www.selinc.com) is committed to providing intuitive, economical cybersecurity solutions that help do both.

As part of these solutions, the new SEL-3620 Ethernet Security Gateway protects site-to-site Ethernet communications as well as private networks, allowing users to maximize the benefits of a Smart Grid while minimizing security risk. Easy to use and tough enough for harsh environments, the SEL-3620 operates with existing IT and control systems, using an intuitive menu-driven Web interface.

SEL designed and built the Ethernet security gateway, available this November, as part of a research project with the U.S. Department of Energy (DOE), Tennessee Valley Authority and Sandia National Laboratories, among other partners.

"The SEL-3620, an OPSAID-compliant device, can provide a synergistic solution that benefits specific needs in securing our critical infrastructure, including Smart Grid communications," said DOE Deputy Assistant Secretary Hank Kenchington. "This is a good example of the DOE, a national laboratory and a private company working together to provide useful solutions to critical needs in a timely fashion."

Another element of SEL's Smart Grid security solutions is the SEL-3021 Serial Encrypting Transceiver. It protects point-to-point and multidrop data links from attacks and eavesdropping, with advanced encryption validated to Federal Information Processing Standards 140-2 Level 2. For wireless applications, the SEL-3022 Wireless Encrypting Transceiver creates a cryptographically secure wireless link between a computer and remote IED serial communications port.

SEL's security solutions provide an effective means for reducing electronic vulnerabilities in critical communications systems ranging from serial to Ethernet and SCADA to engineering access. TDW

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GTR and Electric Utility GIS Trends

By **Mary Ann Stewart**, GITA

WHETHER YOUR ORGANIZATION HAS MAINTAINED GEOSPATIAL SYSTEMS FOR 20 YEARS or is just beginning to implement the technology, it's especially important now to keep up with industry trends. GITA's "2009 Geospatial Technology Report" offers details on how electric utilities are budgeting, implementing, maintaining and integrating geospatial solutions.

This 144-page report contains detailed information on the complexity, direction and completeness of geographic information system (GIS) projects being implemented at 515 organizations — a 9% increase in participation from the 2008 edition. Ninety-seven electric utilities participated in the study, and the respondents represent more than 1.9 million miles (3 million km) of distribution lines, more than 1 billion miles (1.6 billion km) of transmission lines and more than 2.6 million sq miles (6.7 million sq km) of service territory.

"In many ways, we see this report as the answer to a call for help for our infrastructure," said Robert Samborski, GITA executive director. "These are real application examples from electric utilities, communications companies, public sector agencies — just to name a few — that are putting geospatial technologies to work to help own, operate, maintain and protect the infrastructure."

This column previews some of the main findings for the electric utility industry. These research findings have been excerpted from a 22-page electric section of the report, which can be purchased at GITA's bookstore. The full report addresses GIS projects in six infrastructure vertical markets: electric, gas, water, pipeline and telecommunication utilities, as well as the public sector. Information in each industry section focuses on land-base accuracy, sophistication, maintenance cycles, application usage and interfaces, as well as the top 10 applications and technologies.

USAGE OF GEOSPATIAL TECHNOLOGY

The survey asked how many employees in an organization were actively engaged in the use of geospatial technology. Responses ranged from two employees to 4000, providing a total of 43,263 employees from the electric sector. Some of these employees use geospatial technology for only a small portion of their work (as little as 1%), while others use it for as much as 100% of their work. Average use in the electric sector is 22%.

Respondents also were asked to rate the most commonly used geospatial technologies at their companies. GIS topped the list, followed by computer-aided dispatch, information technology, mapping and cartography, enterprise applica-

tions, surveying/GPS, 3-D imaging and visualization, and remote sensing.

KEY GIS ISSUES FOR THE UTILITY INDUSTRY

The survey respondents also shared the top three issues their utilities are facing. Data issues remain important, with data quality control, integration, maintenance in the number two spot, but concerns with mergers and reorganization took first place. Other frequently mentioned issues were asset management, data sharing, workforce downsizing, regulatory compliance and application synchronization. New nominations were condition-based asset maintenance/predictive maintenance, consolidation/integration and reliability of service.

IMPLEMENTATION AT ELECTRIC UTILITIES

Implementing geographic information technology (GIT) at a utility involves a large investment in hardware, software, data and staff. Justifying this expense is based on a return on investment that is typically recognized through improvements in productivity and quality of service generated via the applications of the technology in several areas. These include maps and views, operations and maintenance, engineering work orders, distribution and field automation. Other areas include interfaces with other enterprise systems such as network analysis, outage management, work management and customer information systems.

Utilities reported an increase in street-light maintenance implementations, up from 34% in 2007 to 39% in 2008. Implementations of one-call applications are up from 45% to 49%. Project work currently in the design and development stages should result in a number of joint-use pole billing and transformer load-management projects.

As the GIT pioneers, electric utilities often have the most mature GIS systems. The survey shows that utilities are investing in geospatial technologies. More than 41% of respondents have more than 50 GIS-dedicated mobile computers, and only 7% don't have mobile computers, down 20% from last year. By staying on top of technology and investing in GIS, utilities are improving their efficiency and better serving their customers. **TDW**

Mary Ann Stewart (mastewart@sunflower.com) wrote the "2009 Geospatial Technology Report." She is the principal with Mary Ann Stewart Engineering, LLC, which she founded in 2003. She has specialized in the geospatial technology industry since the early 1990s and in the utility industry since the mid-1990s.



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Reaching New Heights

By **Stefanie Kure**, *Contributing Editor*



Terry Neighbours, *ABB Inc.*

A PASSION FOR WORLD WAR I AND WORLD WAR II AIRPLANES keeps Terry Neighbours' head in the clouds sometimes. Nevertheless, the 24-year veteran of ABB Inc. (Cary, North Carolina, U.S.) makes sure his feet are planted firmly on the ground when it comes to what's important in life, such as family, friends and career.

"I try to live life and love life each day by doing things that offer me rewarding experiences and unique opportunities," said ABB's manager of engineering & project management, power products division — medium-voltage products in Lake Mary, Florida, U.S. "You never know what the future holds or when you will be able to do the things you enjoy again."

During his almost quarter-century at ABB, Neighbours has worked in nearly every department, including wiring, assembly, paint and quality assurance (QA), at several of the company's factories. He has steadily climbed his way up the corporate ladder to become a project engineer, QA manager, project manager and, ultimately, engineering manager. Despite his successful career at one of the world's leading power and technology companies, Neighbours admitted he did not plan on a career in the power industry.

"I grew up in the rural town of Inola, Oklahoma," he recalled. "My entire family was involved in the aircraft industry. My grandmother was a 'Rosie the Riveter' type who built P-51 Mustang parts during World War II, and my father worked at the Tulsa, Oklahoma, McDonald Douglas and Rockwell factories during the Vietnam War and Cold War. I always figured I would follow in their footsteps."

But Neighbours' parents encouraged him to get a career in something other than the aircraft industry, because the work was so inconsistent.

"That meant it was either feast or famine," he explained. "Instead, I decided to pursue an engineering degree while still keeping a passion for flight." Neighbours attended college on an academic scholarship and played baseball, but dropped out before graduating.

"Back then, I thought I was too smart for school," he laughed. "So I went to work as lead electrician for a company that built commercial mobile home units for railroads. From there, I joined a company called BBC. BBC merged with Asea and became ABB. I've been here ever since."

Neighbours eventually earned a degree in organizational management, and his career took him to Lake Mary, where today he manages 35 people at ABB.

"I enjoy my job because of the challenges that arise from day to day," he said. "There are similar circumstances, but the details are different enough that it seems like a new scenario."

Living in Florida has allowed Neighbours to indulge his enthusiasm for "warbirds." He volunteers at the Valiant Air Command Museum in Titusville, which is dedicated to finding and preserving historic aircraft.

"The museum houses a mix of planes, including those from World War I, World War II, the Korean War, the Vietnam War and modern aircraft," he noted. "We attract more than 120,000 visitors a year. My involvement in the museum has allowed me to participate in restoring three aircraft."

Although that may not seem like a large number to some, Neighbours said warbird restorations can take four to 10 years. To raise funds for the renovations, the Valiant Air Command hosts the TICO Warbird Airshow each March, which Neighbours helps organize.

"I have plans to get my pilot's license, so I can actually fly these planes," he added.

As passionate as Neighbours is about flight, he is equally as zealous about delving into new opportunities and continues to learn more about all aspects of business at ABB.

"I'd like to learn more about sales and marketing and product development," he said. "I'd also like to become more involved with the customers in our business."

For those wanting a career in the power industry, Neighbours recommends finding a college with an electrical engineering program that has a focus on power systems.

"This is a hard field to get into with just an electrical engineering degree," he remarked. "People who walk in here want to be an engineer for switchgear. They know the basics of electrical engineering, but they know little about switchgear systems, controls and the product line itself. I tell them to educate themselves about our products and learn as much as possible about design standards such as ANSI 37.20.2 and ANSI 37.20.3 that relate to switchgear. They need to do a lot of research, and they need to be prepared for a lot of on-the-job training."

When he isn't working or volunteering, Neighbours enjoys bird hunting, fishing and scuba diving. He recently added another hobby — training his Labrador Retriever puppy, Dixie.

"I have so many hobbies that I don't have time for all of them," he joked. "However, my wife and I are setting aside plenty of time in December, because that's when our first grandbaby is due." **TDW**

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At the time of the December 2008 storm, Green Mountain Power had not fully implemented the mobile aspect of its new system. Therefore, four dispatchers ran switching orders to the field crew leaders via cell phone texting or radio; in turn, field reported back to dispatch, who updated Responder when an outage was picked up.

Up to the Task?



Green Mountain Power credits its integrated outage management system for reducing power outage durations after a brutal winter storm.

By **Josh Castonguay**, *Green Mountain Power*

GREEN MOUNTAIN POWER WAS ADVISED THAT A GEOGRAPHIC INFORMATION SYSTEM UPGRADE is typically implemented in several phases over the course of two or more years. However, the utility chose to expedite the migration process and targeted deployment within one year. Green Mountain Power (Colchester, Vermont, U.S.) completed its GIS upgrade in early fall 2008, in part to expand its outage management system (OMS) functionality.

The migration team worked doggedly since project kickoff the prior November. The implementation pace soon had team members wondering if they'd taken on more than they could handle. However, when an ice storm in December 2008 arrived, they realized they had made the right decision to race to deployment.

THE NEED FOR INTEGRATED OMS

Green Mountain Power, owned by Northern New England Energy Corp. (South Burlington, Vermont), provides electricity to approximately 165,000 people in Vermont — about one-fourth of the state's population. For six years prior to 2007, the utility had successfully used an AutoCAD-based GIS/mapping system with a homegrown OMS that worked on top of Microsoft MapPoint. But by 2007, the operations and engineering groups and control center units all acknowledged this system had reached its full potential of functionality:

- The system could not determine the protective device that was open and responsible for the outage. Only if the customer called, and the customer was found in the system, did it map the incident.
- The storm-response team had to sort through a long list of people who had called about outages; there was no easy way to group them to make the response efficient.
- The system did not show the actual distribution or transmission lines — only the streets and sometimes the poles — and did not indicate the direction of distribution feed.



Dave DeGrasse, control center operator, was one of eight dispatchers rotating shifts of 15 to 18 hours at one of three district offices during the eight-day outage response. Here in the Colchester control center, dispatch used the desktop screen on the left to view the status of non-OMS-linked generation assets such as hydros and gas turbines. The center screen provided real-time geographic views provided by the OMS, while the screen to the right showed the real-time OMS incident management report. SCADA information was viewed on the separate screen to the far right of the dispatcher. The overall sub-transmission system viewed on the wall in front of the dispatcher showed real-time power flows and voltage.

Little did they know then that those long days of design, development and deployment were just a boot-camp preparation for the active duty ahead.

RESPONDER PUT TO THE TEST

The storm, now considered the worst ice event in southern Vermont history, started the evening of Thursday, Dec. 11, 2008. It lasted 12 hours, during which time the governor issued a state disaster declaration for Vermont's southernmost counties: Bennington, Windham and Windsor. Those three counties are part of Green Mountain Power's southern division, comprised of the Wilmington, Westminster and White River service areas.

While everyone on hand was glad to have the Responder OMS in production at the time of the ice storm, not many of the staff had yet been brought up to speed on the software. However, the few who endured the GIS migration boot camp were comfortable with the system. One person, stationed at the Colchester control center in the utility's western division, monitored real-time incident information sourced from all three of Green

Mountain Power's divisions; a dispatcher in each of the White River, Westminster and Wilmington satellite offices viewed the OMS real-time data and dispatched Green Mountain Power's 26 two-man crews, along with support crews from contract resources and other utilities.

The evening of the storm, the team received an e-mail from the project liaison at Telvent (the GIS vendor) asking if all was okay. The team's brief response was contained to the subject line of the reply:

"Mike Burke"
12/12/2008 05:24 AM

To: Telvent
cc:

Subject: Responder getting tested, no time to talk but we've got over 10,000 people out and it's still icing. 2 whole districts are more or less in the dark. Westminster & Wilmington. will send you updates on how Responder is running.

With limited experience since rollout, the team was pleased the vendor offered to help and gladly accepted support, through wireless, on a few issues.

EMPOWERED WITH REAL-TIME INFORMATION

Interfaced with the call center and IVR, the Responder OMS received about 7500 calls over the course of the event, automatically identified customer location and logged the incidents, and provided a Web-based, real-time incident management report. Between the call center staff, management

MIGRATION TO ENTERPRISE GIS

With its relatively small staff (fewer than 200 employees), Green Mountain Power has a customer-employee ratio of 485-to-1, roughly twice the industry average. The staff needed to get optimum mileage from the utility's geodatabase to help make internal business processes as efficient as possible.

The utility chose to migrate to the object-oriented ArcGIS platform from ESRI (Redlands, California, U.S.) and Telvent's (Fort Collins, Colorado, U.S.) ArcFM Solution based on ArcGIS, developed specifically for utilities. Also chosen were the ArcFM-hosted Responder OMS and ArcFM mobile extensions that would send field updates to the enterprise geodatabase and make up-to-date electric infrastructure data available efficiently to engineers and designers.

The migration involved workflow analysis, configuration of the ArcFM GIS and conversion of the network assets database containing GPS coordinates of 90 substations, 95,000 meters, approximately 90,000 poles and all load points in between. The team also took advantage of the open architecture of the new system to interface the Responder OMS with the existing Banner interactive voice recognition (IVR) and FleetHawk automated vehicle location (AVL) systems.

Green Mountain Power management gave the responsibility of implementing the GIS and OMS to the staff who would be using it. The core migration team — consisting of a networking principal, two engineering designers and a GIS administrator — adopted ownership of the new system from the very start, logging many long days until the go-live late in September.

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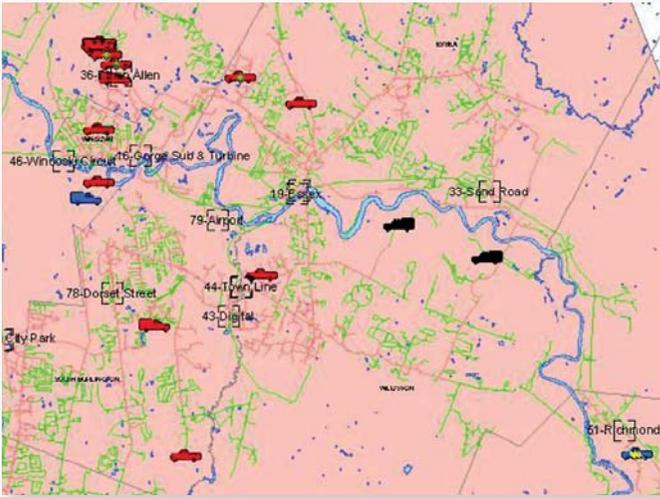


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Responder, integrated with vehicle location software, shows real-time vehicle location; here, truck color reflects division affiliation. The colored area shows the extent of the district, and the green and red lines represent actual circuits.

and staff from other departments, approximately 30 people were using the Responder OMS Web interface at any given time and could read the most-current number of customers affected, identify locations of outages and view the AVL truck locations. If a callback was requested by a customer, the person taking the call was able to flag it in the incident management report so the call center could follow up.

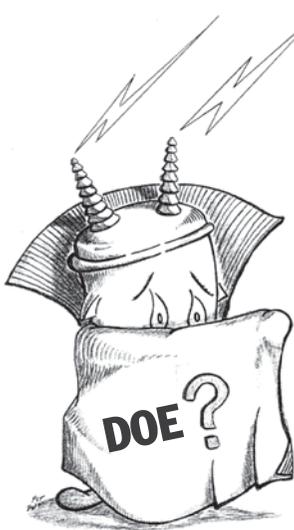
The electrical connectivity of the Responder model predicted the extent of the outage based on the asset status, allowing the storm team to identify what locations were affected even without receiving an outage call. This was particularly helpful because some of the affected area included winter vacation/ski residences not occupied at the time. With the older OMS, the response effort likely would have missed some of those homes — which were soon to be occupied by holiday visitors.

With a real-time accounting of actual calls and a predicted extent of the outage, dispatchers could focus on the incidents with the highest customer count or those incidents considered critical because life support or oxygen supply were involved. From there, dispatchers could work down to single-customer outages, helping to make the restoration effort as efficient and effective as possible.

BENEFITS OF OMS

The average outage duration was 17 hours, and the Green Mountain Power staff is convinced the Responder OMS helped to minimize this average restoration time by making crew dispatching more efficient. The OMS provided the following benefits during the outage:

- The exact count of customers out of service.
- The ability to pinpoint the tripped protective device and direct line crews to it.



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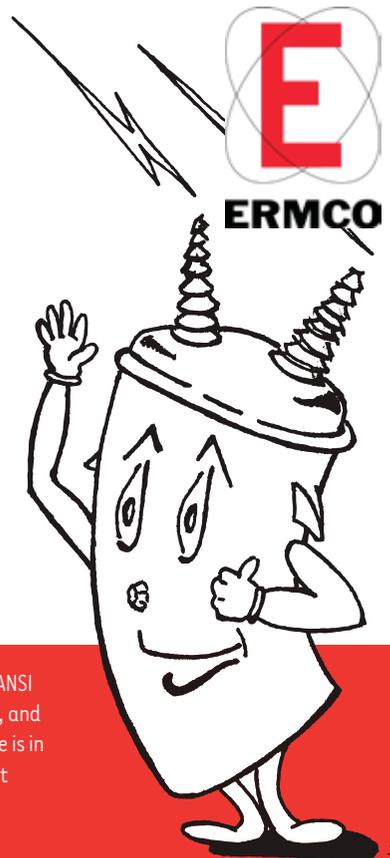
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The hundreds of companies exhibiting in New Orleans are aware of the changes that are occurring in the industry and through their commitment to the industry, they will be displaying the latest products and technologies available to satisfy the changing worldwide demand.

GIS Allows Expanding Capabilities

Even with its relatively small staff, Green Mountain Power (Colchester, Vermont, U.S.) has exceeded conventional service-quality standards, including those set by Vermont regulations. With its investment in the open-architecture GIS — which now serves across Green Mountain Power's operations, engineering and customer service businesses — the utility expects to meet even higher performance standards.

Green Mountain Power is completing integration of its supervisory control and data acquisition (SCADA) system with the Telvent (Fort Collins, Colorado, U.S.) Responder. This integration will enable real-time asset data to be fed directly to the outage management system (OMS) for all Responder users to view. This approach allows staff to pinpoint the device that is open before waiting for the field to confirm or even for the calls to come in. Staff will be able to efficiently dispatch crews to the correct locations the first time.

Currently, Green Mountain Power has 20 users of ArcFM and Designer, the graphic design application based on ArcFM, taking advantage of a full set of compatible units that connects with the customized estimating system. This integration standardizes and streamlines the design process by creating a job estimate without manual calculations or separate spreadsheet files.

Furthermore, each field crew truck now has a laptop computer with ArcFM Viewer, an extension that gives them the ability to see more detailed information. Soon crews themselves will be able to see the outage data from the OMS. This availability of real-time information will help to streamline work, from service calls to emergency responses.

The state of Vermont maintains a Web site showing all current outages throughout the state. Green Mountain Power developed the site, www.vtoutages.com, which allows utilities to either manually upload outage information or automatically upload from an OMS. Responder will automatically feed the site and provide real-time information for state officials.

Most recently, Green Mountain Power added a leading-edge customized application from ESRI (Redlands, California, U.S.) that interfaces the GIS with land-base files, renewable-energy data files, and wildlife pattern files to identify green zones, or areas of the state most suitable for wind and solar power generation.

This growth capability is what Green Mountain Power envisioned when it implemented the ESRI-Telvent GIS system. In a time when the energy environment is changing so quickly, this utility is very glad to have adopted a platform that offers such flexibility.

- A map of the system showing all the outage and truck locations in real time. The call center staff members accessing this information through a Web interface were able to provide up-to-date information to customers as they called in.

- The ability to run crews through the entire restoration with minimal software support (one lead dispatch and a local dispatch in three other satellite offices).



While a local police officer collected event information, a Green Mountain Power line worker dismantled hardware on a broken pole. During the December 2008 storm, ice was reported to be more than 1-inch thick in places, wreaking havoc on power poles typically rated to tolerate up to a one-half inch of ice on the conductors.

- The ability to place non-electric incidents on the map for post-storm follow-up, such as incidents where service was energized but pulled off the house or where a tree fell on a service. An appropriate symbol on the map allowed staff to print follow-up maps that streamlined post-response cleanup effort by the crews.

Another plus was that there was no observed impact on the Responder's performance as the number of total incidents increased. This was a significant improvement over the legacy system, which often locked up after 10,000 or more incident entries.

After all the pieces were picked up, everyone's lights were back on, and the storm team caught up on sleep, the utility received recognition from the state of Vermont legislature, commending the employees and leadership of Green Mountain Power and those utilities and companies assisting it in restoring power after the ice storm.

Road crews from several local towns sanded the roads voluntarily so that electric crews could access damaged assets. Support also included a number of restaurants that provided food and water, hotels and motels that allowed weary electric crews to catch much-needed sleep, businesses that supplied needed materials, and public and emergency services that provided invaluable assistance.

Green Mountain Power couldn't have done it without them or the Telvent Responder outage management system. **TDW**

Josh Castonguay (castonguay@greenmountainpower.com), lead engineer at Green Mountain Power, was technical lead in implementing the ArcFM / Responder project at Green Mountain Power. He supervises seven electrical engineers who plan and design substations and transmission and large distribution infrastructure. He is now highly focused on the development of sustainable energy in Vermont, working with the state of Vermont and other local utilities in projects developing solar, wind, methane and other renewable-energy sources. He earned his BSEE degree at the University of Maine and has been employed at Green Mountain Power since 2003.

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Onshore Solution for Offshore Wind

Danish utility installs a static VAR compensator to prevent voltage instability.

By **Niels Andersen** and **Michael B. Hansen**, SEAS-NVE

IN 2003, THE NYSTED OFFSHORE WIND FARM, WITH AN INSTALLED CAPACITY OF 165.6 MW, was commissioned on the island of South Zealand in southern Denmark. The wind turbines are equipped with asynchronous generators with squirrel-cage rotors. Studies supported by operational experience have confirmed the wind farm was the source of unacceptably large and frequent voltage fluctuations on the 132-kV transmission system.

The voltage disturbances were due to a combination of a weak 132-kV transmission system and large variations in the reactive power-flow exchange between the wind farm and the transmission system. The reactive power flow at the Radsted substation was due to the absorption of the reactive power in the magnetisation of the wind turbines, transmission cable and 132/33/33-kV transformers. The grid interconnection at Radsted was more than 100 km (62 miles) from the nearest conventional power plant and the country's strong 400-kV transmission system.

To reduce the voltage fluctuations, SEAS-NVE (Svinninge, Denmark) decided in the spring of 2005 to install a static VAR compensator (SVC).

TRANSMISSION SYSTEM IN EASTERN DENMARK

The transmission system in eastern Denmark comprises 400-kV and 132-kV transmission lines, cables and existing interconnectors with southern Sweden and Germany, with plans in the works for yet another interconnector to the Danish island of Funen.

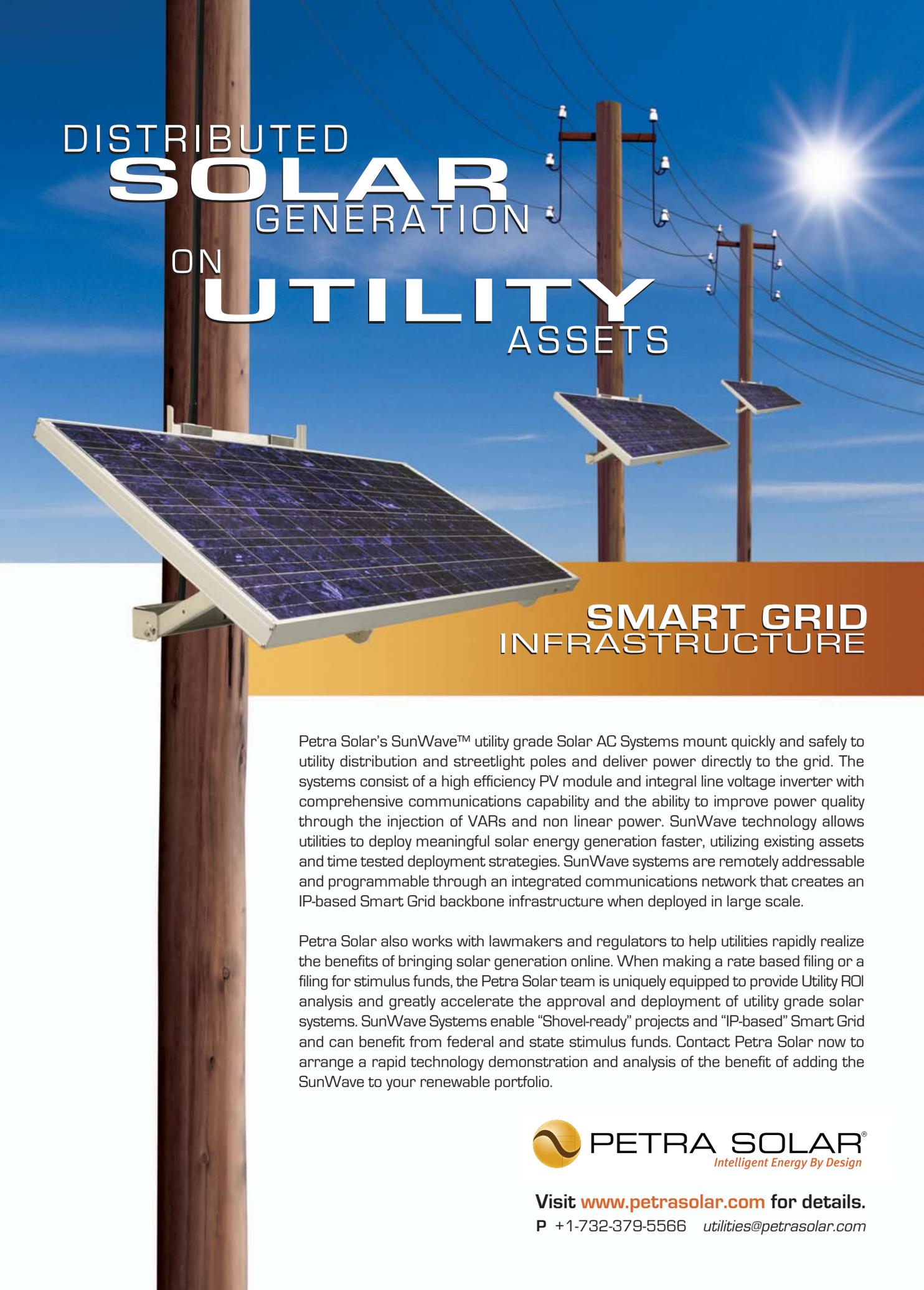
The Swedish interconnector — which includes four AC cables, comprised of two 400-kV cables and two 132-kV cables — has a transfer capacity of 1900 MW and links Denmark to the Nordic grid. The interconnector to Germany is a 400-kV high-voltage direct current (HVDC) transmission system with a transfer capacity of 600 MW. The planned interconnector to Funen will be a 600-MW HVDC transmission system. Currently, in eastern Denmark, the installed generating capacity is 4360 MW supplying a maximum demand of some 2870 MW.

SELECTION OF THE SVC

To comply with existing European Union Grid Code legislation, it is necessary to provide power and dynamic-controlled grid voltage to enable a grid interconnection. The equipment installed to control the grid voltage can be incorporated in the wind turbines or sited in the onshore AC substations. Wind farms that are increasing the installed generating capacity are now regarded as power plants, and wind turbines are becoming more complex with the need to install more equipment to comply with the Grid Code. In addition to increasing the cost and maintenance of wind turbines, there are concerns



The map shows 400-kV and 132-kV transmission systems in eastern Denmark, including the northeastern interconnector with Sweden and the southern interconnector with Germany.



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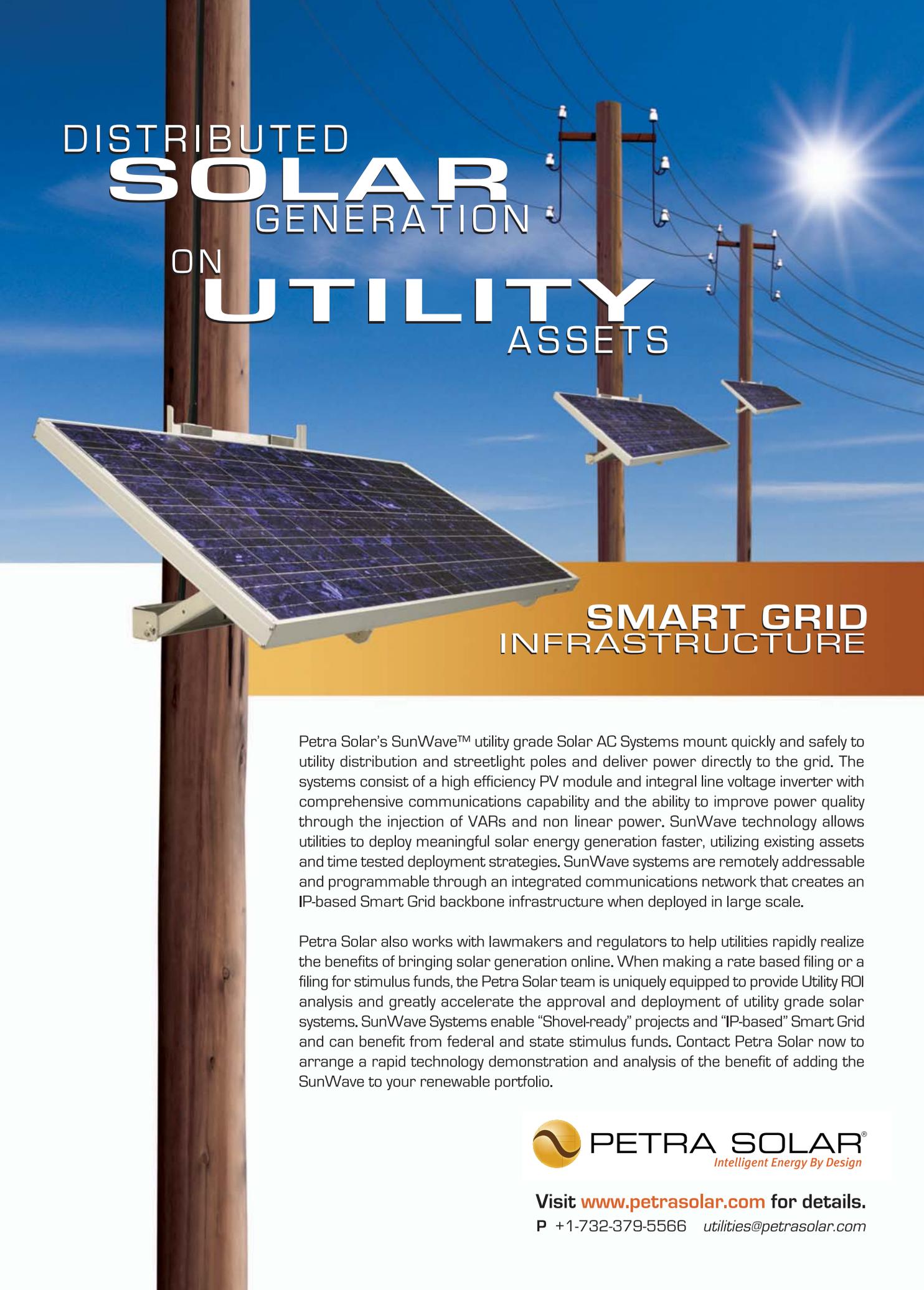
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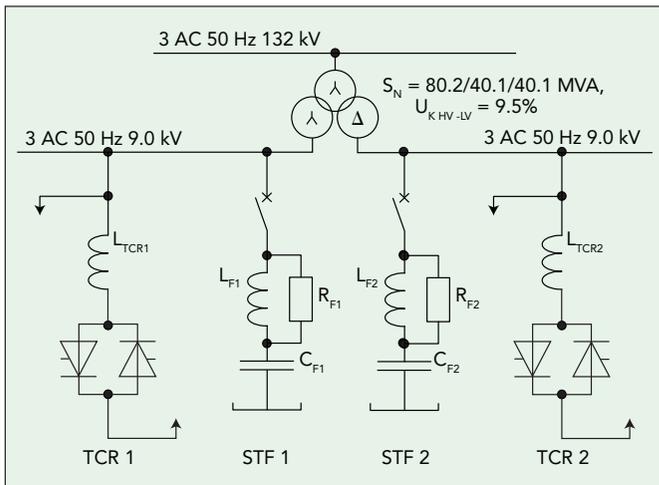
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Line diagram showing the SVC connections to the 132-kV system.

these demands could adversely affect availability of the wind turbines.

The Nysted Offshore Wind Farm was designed to minimise the equipment installed in the harsh offshore environment, so the SVC was installed onshore, providing additional supply opportunities to support the transmission system during faults.

THE RADSTED PROJECT

In Denmark, transmission system projects require approval by the energy and local authorities to ensure the proposal



The thyristor-controlled reactors installed in the buildings.

satisfies all environmental standards, thereby securing local acceptance.

SEAS-NVE in cooperation with Energinet.dk (Fredericia, Denmark), the Danish transmission system operator, considered the dynamics of the complete transmission system by undertaking system stability studies to determine the rating of the SVC. To allow the normal operational requirements and for fast changes in the wind farm's production, ratings of 80-MVAR capacitive and 65-MVAR reactive were specified for the SVC.

The SVC for the Radsted project was based on conventional technology using two thyristor-controlled reactors (TCR) and two filters. Because of the requirements on size and permitted noise, the SVC was designed as a 12 pulse; a six pulse is the norm used in an SVC. The 12-pulse SVC optimises the size of the building required to accommodate the complete SVC and reduces the filtering requirements, thereby making the SVC silent.

The project specification was completed in late 2004. January 2005 to March 2005 was allocated for tenders; SEAS-NVE invited pre-qualified bidders to offer costs for a SVC solution. In June 2005, Siemens Wind Power A/S (Brande, Denmark) was awarded the turnkey contract for the supply, installation and commissioning of the SVC in accordance with the unit rating determined by SEAS-NVE.

During the design and engineering phase of the Radsted project, technical issues were clarified and SEAS-NVE prepared the site for onshore installation work:

- Re-routing existing 10-kV overhead lines
- Constructing a new road and leveling the building site
- Tree planting to screen the proposed installation
- Extending the existing 132-kV bus bar.

The building that would house the SVC was completed by fall 2006. It has an area of approximately 825 sq m (8880 sq ft) and a height of 6 m (20 ft). The building works were performed in parallel with the installation of the indoor SVC.

The building, which externally has the appearance of a conventional barn to blend into the existing landscape, was designed to limit noise emission. Also, due to the high-created magnetic fields present in the area that accommodate the TCRs, this enclosure had to be constructed without introducing closed metallic loops in the roof structure and floor. Special design features in the building allow a large volume of airflow to dissipate the heat generated by the reactors and filters.

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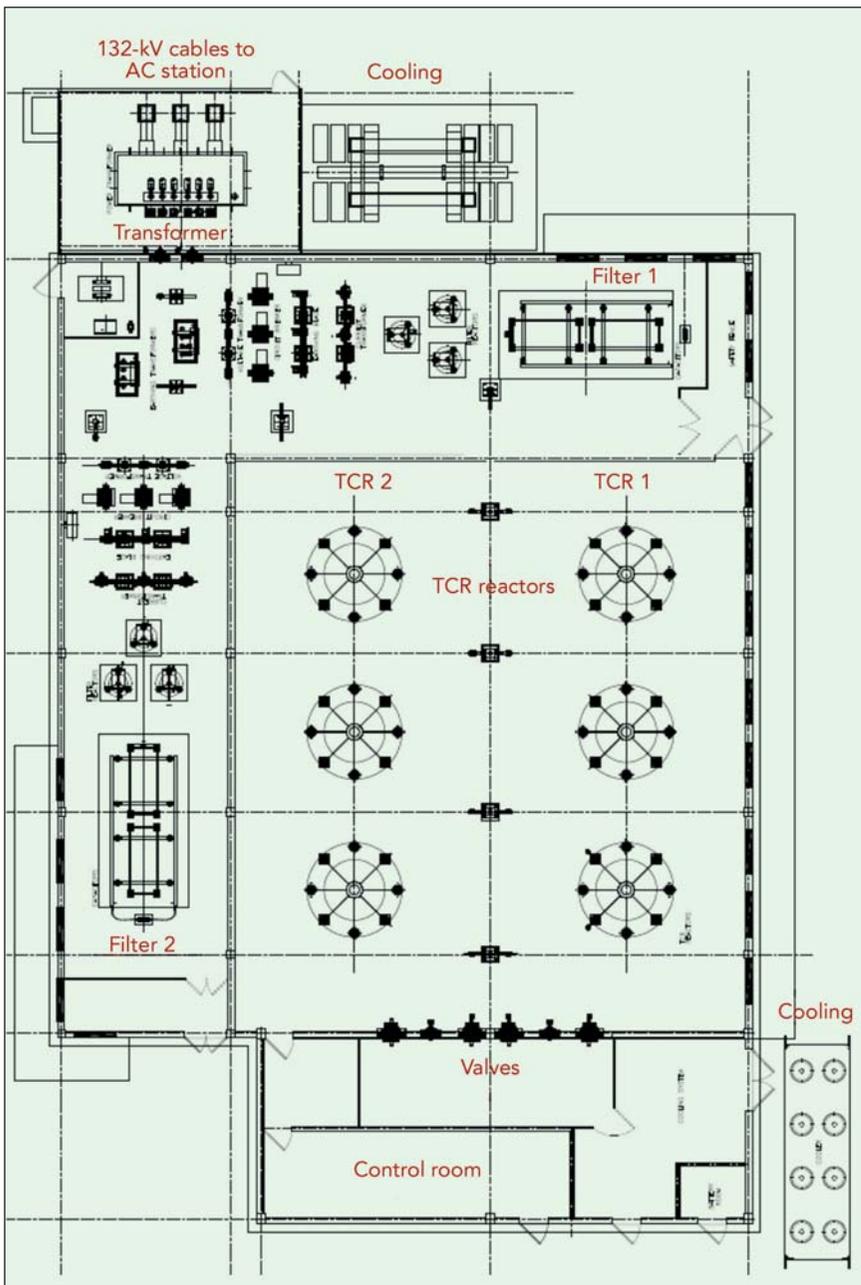
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External view of the SVC building.



Plan view of the plant layout in the SVC building.

The SVC transformer is an oil-immersed, naturally cooled transformer type with separate coolers. The transformer is positioned on an anti-vibration foundation, designed to retain any oil that leaks from the transformer or radiator, and is placed in a separate sound-proof enclosure. The outdoor coolers from the valve cooling system have low-noise fans.

In the course of the design, special attention was given to the limited space within the building to ensure there was sufficient access for the tools and equipment required to complete all future maintenance on the SVC.

The pre- and post-commissioning tests were performed by a team comprising Siemens A/S and SEAS-NVE staff, an exercise that also provided training for the utility personnel. The tests proceeded as planned, but minor design changes were necessary because of the high magnetic field generated by the TCRs.

FIELD TESTING

To determine the rating of the filters in the SVC, harmonic measurements were taken simultaneously with the main circuit design of the SVC. The harmonic level measured in the preliminary studies indicated the need for a SVC with a substantial rating; therefore, SEAS-NVE decided that further monitoring was required prior to energisation of the SVC.

The harmonics were measured on the 132-kV bus bar at Radsted in 10-minute intervals for a six-month period. Table 1 shows the harmonic levels recorded in each circuit for week 27 and the maximum values recorded during the period of monitoring.

As expected, the SVC filters reduced the harmonic voltages on the 132-kV bus bars but created currents in the SVC filters. These currents can be calculated using the design criteria for filters (see CIGRÉ Working Group 14.30's "Guide to Specification and Design Evaluation of AC Filters for HVDC Systems") by applying the harmonic voltage to the impedance:

$$Z_{GRID} + Z_{TRANSFORMER} + Z_{FILTER}$$

The harmonic currents calculated using the CIGRÉ criteria when consid-

ering a 132-kV grid with cables instead of overhead lines are quite significant in deciding the rating for the filters. Table 2 shows the currents for the SVC based on the rating study compared with the harmonic currents measured during the trial period

Table 1. Harmonic levels on the 132-kV bus bars prior to installing the SVC.

Harmonic	Line 1 (max.) % of V_N		Line 2 (max.) % of V_N		Line 3 (max.) % of V_N	
	Week 27	Max. level	Week 27	Max. level	Week 27	Max. level
3 rd	0.43	0.46	0.23	0.29	0.25	0.41
5 th	2.07	2.25	2.28	2.44	2.14	2.30
7 th	1.22	1.34	1.08	1.36	1.13	1.53
11 th	0.01	0.20	0.02	0.03	0.01	0.05
13 th	0.21	0.23	0.16	0.23	0.16	0.21

ACCEPTABLE SOUND LEVELS

In Denmark, acceptable disturbance levels in a rural environment have been a key issue for many years. The public’s focus on the issue is increasing while the allowable and acceptable noise levels are decreasing. There are no exceptions to the legislation, and expensive remedial measures have been made to existing substations in order to comply with the new requirements.

The SVC and Radsted substation are close to a residential area, which means the noise from the complete installation at the neighbour’s boundary must be below 35 dBA. When the SVC specification was decided, various authority approvals had not been granted, including the precise location of the substation, so that residences could have been between 10 m to 50 m (33 ft to 164 ft) from either side of the SVC. To avoid delays to the construction project, a larger site for the Radsted substation was obtained to ensure the boundary noise level did not exceed 30 dBA. Following commission-

Table 2. Currents in the SVC filter.

Frequency	Calculated using the CIGRÉ criteria		
	Measured current from the grid (A)	Total calculated rating current (A)	Current from the grid (A)
150 Hz (3 rd harmonic)	1253	376	74
250 Hz (5 th harmonic)	1347	968	98
350 Hz (7 th harmonic)	406	254	47
550 Hz (11 th harmonic)	64	17	4
Rated current	3550		

ing of the SVC, the sound level at the closest neighbour was measured at 18 dBA.

ACCEPTABLE MAGNETIC FIELD LEVELS

Magnetic field levels are regulated and must comply with the April 29, 2004, European Union Directive 2004/40/EC on the minimum health and safety requirements on exposure



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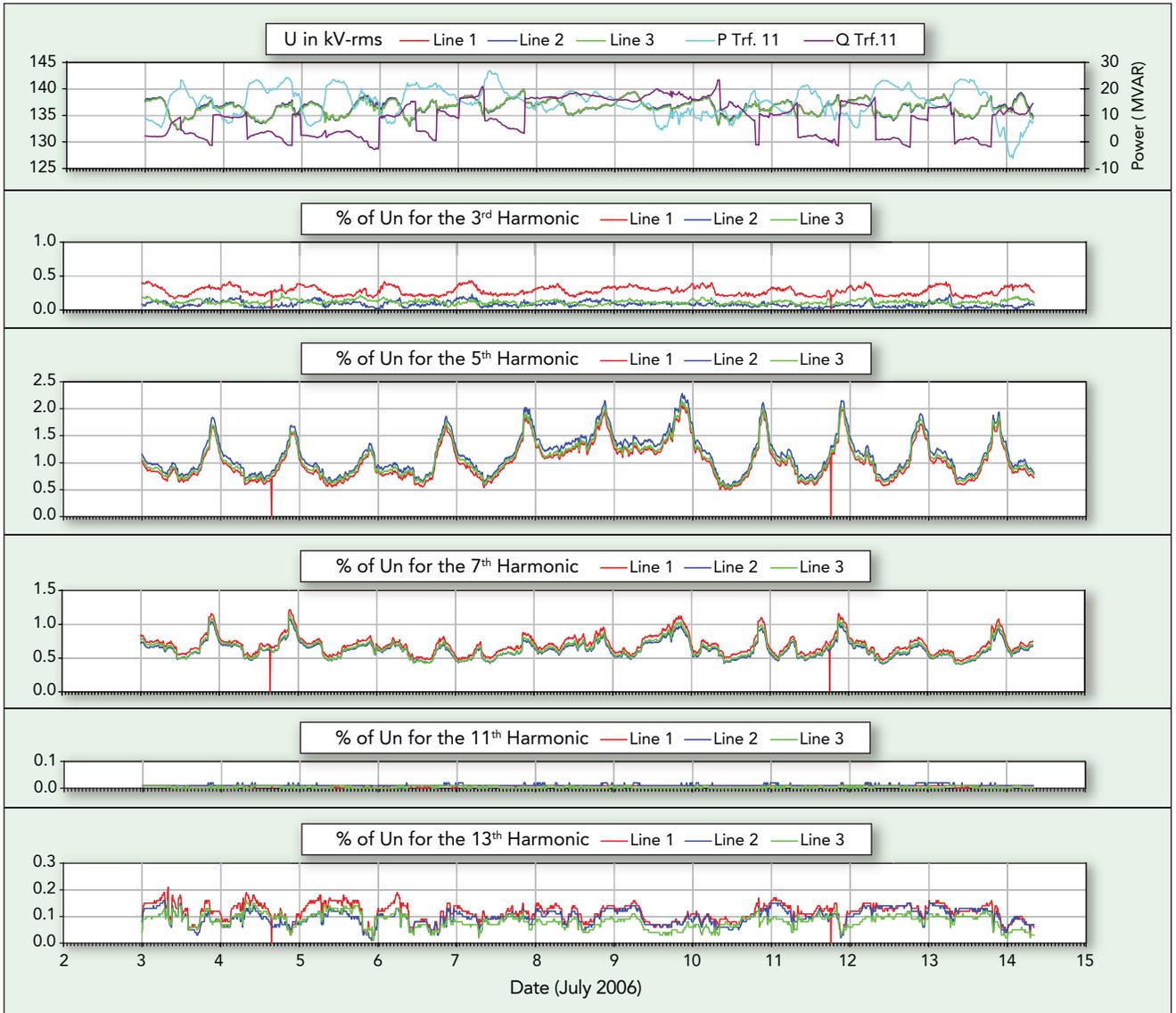
Table 3. Magnetic field strength results with a 20-MVAR inductive load.

Position	Frequency (50 Hz) Magnetic field (µT)		Frequency (150 Hz) Magnetic field (µT)		Frequency (250 Hz) Magnetic field (µT)		Frequency (350 Hz) Magnetic field (µT)		Frequency (450 Hz) Magnetic field (µT)	
	Measured	Calculated	Measured	Calculated	Measured	Calculated	Measured	Calculated	Measured	Calculated
P11	369.8	399.5	105.1	91.2	31.7	30.4	13.5	14.6	11.9	8.1
P1	82.8	67.9	22.2	33.9	6.0	4.9	2.4	2.5	1.3	3.0
P3	65.8	61.5	22.2	21.2	4.5	4.7	1.7	2.3	0.9	1.9
I5	465.6	470.9	166.5	165.5	35.6	35.9	15.2	17.3	123.4	14.8
P15	329.6	383.3	88.4	86.3	26.7	29.2	11.4	114.1	9.5	7.7

levels for workers and the general public. This directive includes action values on the magnetic field and the limits on induced current density for head and trunk. Action values can be measured but the limit is more difficult to obtain. As a safety precaution for the Radsted SVC project, SEAS-NVE decided to apply the action value as the limit value. The current in the main reactors and filter reactors both contribute to the SVC magnetic field. Since these currents have a harmonic content, the magnetic field limits are frequency-dependant.

It was necessary to calculate the magnetic field strength under different operating conditions as the maximum value may not correlate with the maximum current. To verify the calculations, measurements were taken at three different positions for inductive loads of 65 MVAR and 20 MVAR and for a 30-MVAR capacitive load. Table 3 shows the results obtained using the 20-MVAR inductive load.

The measured and calculated values are in close agreement, with the minor differences probably being due to the



Measurement of the harmonics on the 132-kV grid.

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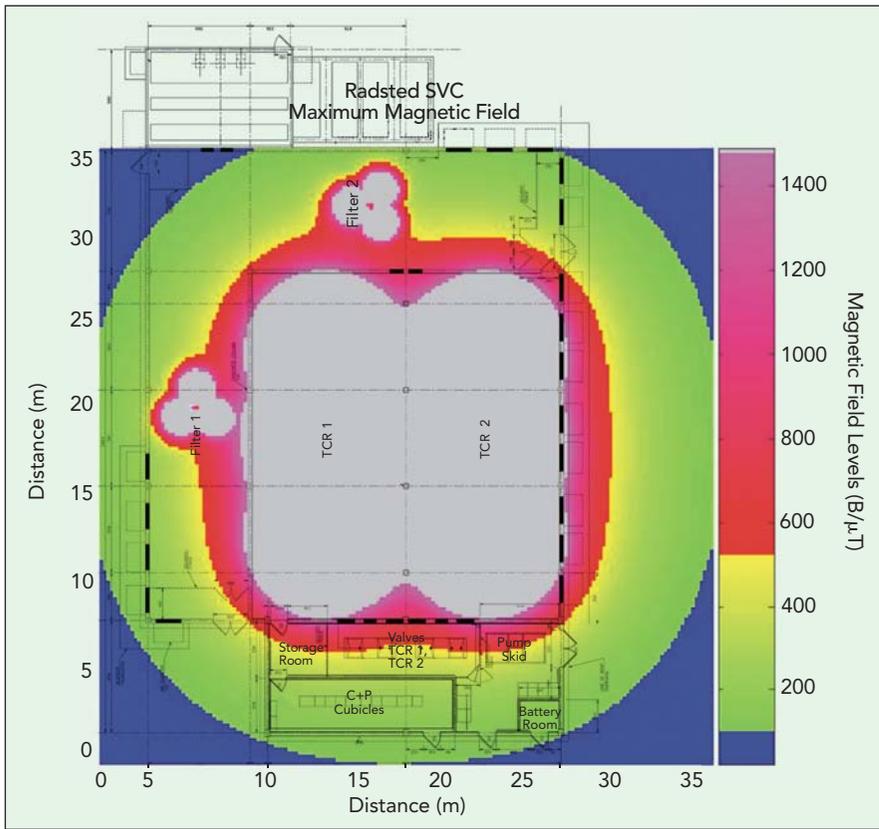


Image shows the magnetic field strength from the SVC.

as expected, delivering full reactive capacity during the failure and thereby supporting the system voltage and ensuring system stability. The event had no impact on the output of the Nysted Offshore Wind Farm.

The rapid development of generation from wind farms in Denmark has increased the problems of supply reliability and system stability. Wind farms are now regarded as a reliable source of energy to support the transmission system during normal conditions and in outages attributable to system faults and conventional power plant downtimes for maintenance.

The Radsted SVC has demonstrated that the 165.6-MW Nysted Offshore Wind Farm is now a source of electricity generation, connected to a very weak 132-kV transmission system without any adverse effect on the system voltage or stability. The SVC installation proved to be an environmentally acceptable project, constructed with the support of the planning authorities to minimize the impact on the local community. **TDW**

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deviation between the positions used for measurement and calculation. The calculations were repeated 30 times from full inductive (firing angle of 90 degrees) to full capacitive (firing angle of 180 degrees).

In the ure showing the magnetic field strength, the blue-green border at 100 μT (at 50 Hz) is the action limit where the public has access and yellow-red at 500 μT (at 50 Hz) is where authorized personnel have access.

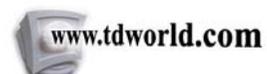
OPERATIONAL PERFORMANCE

An additional benefit attributable to the installation of the SVC is the prevention of induction generators from disconnecting from the transmission system in the event of an outage, reducing the stress on the wind turbines. This characteristic is limited to induction generators, which form the majority of wind turbine generators connected to the Danish transmission system.

The performance of the SVC installed at Radsted was proven when in April 2007, there was a transmission system outage on Amager Island near Copenhagen, Denmark, some 140 km (87 miles) away SVC. The SVC operated

Niels Andersen (na@seas-nve.dk) received a MSEE degree from the Technical University of Denmark and was employed by ABB Power Systems in HVDC until 1994. Since then, he has been employed by SEAS-NVE, where he works on HVDC and Flexible AC Transmission System (FACTS) applications. His current main areas of work include project management, system studies, feasibility studies, specifications for HVDC/FACTS and offshore wind farms.

Michael B. Hansen (mbh@seas-nve.dk) received a BSEE degree from the College of Copenhagen and was a consulting engineer working for the Denmark railways until 1994, when he joined SEAS-NVE to work on HVDC and Flexible AC Transmission System applications. His current responsibilities as a commissioning and project engineer include transformers, protection, SCADA and measurements.



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National Grid Pilots DA

New York utility is establishing the value relationship of distribution automation for use when weighing options for improving reliability.

By **Vincent J. Forte Jr.**, *National Grid*

A DISTRIBUTION AUTOMATION PILOT PROJECT IS IN PLACE AT NATIONAL GRID that will establish the value relationship between distribution automation (DA) and other options at the utility's disposal for maintaining and improving reliability performance. The DA pilot is also informing National Grid's (Waltham, Massachusetts, U.S.) Smart Grid pilot, which is much more ambitious than DA alone.

These are some of the issues being addressed in the DA pilot and being vetted through firsthand experiences:

- To which circuits should DA be applied?
- Which technology should be used?
- How should the value be measured?

DA includes automation of both distribution (15 kV and below) and subtransmission (23 kV to 69 V) systems. While DA includes supervisory control and data acquisition (SCADA) capability, it is much more than that. The control system sectionalizes (using feeder breakers, reclosers and switches) to reduce the number of customers interrupted and aid crews in trouble location, communicates back to dispatchers where a fault current has occurred or not occurred (using data from devices and fault indicators) and restores as much of the system as possible through alternative sources, but it does all this faster than human intervention (switching manually in the field or using SCADA) can accomplish.

Additionally, DA allows the equipment to "think" by knowing if there is capacity available in real time from an alternate source. This allows as many customers as possible to be restored very quickly in real-time conditions.

FIRST STEPS

In 2003 and 2004, National Grid began investigating DA and potential benefits for the system and customers. At that time, the utility determined that addressing root causes through normal mitigation measures was most cost-effective.

Figure 1 shows a combined view of the cost benefit of these various programs from that time. Each point on the curve is a feeder on National Grid's system and is color-coded by the mitigation program applied. Thus, a feeder would have several points on the curve, one for each program examined. The figure illustrates that the value of the first DA project was well up on the cost-benefit curve.

The expectation was that in a couple of years, the utility would have captured the most cost-effective benefits and moved up the cost-benefit curve to a point where DA value would be relatively comparable to other mitigations. National Grid expected that the DA capability would continue to improve and hoped the cost also would improve or at least remain stable.

Improvement in DA technology did indeed happen and costs remained stable. National Grid captured the low-hanging fruit by addressing root causes. The utility improved its reliability performance, digging out of the regulatory penalties it used to accrue. As the utility approached the cost-benefit

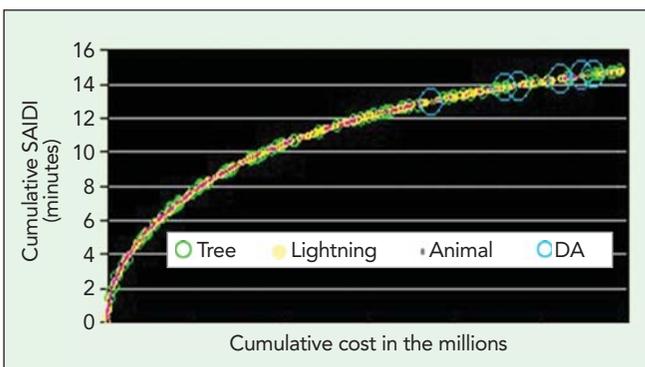


Fig. 1. This cost-benefit curve was generated based on New England data only (New York data was excluded).



A lineman installs a 35-kV switch in the Syracuse, New York, area. (Photography by John McDaniel, National Grid.)



On this 24-kV switch, note the opened control box. (Photography by John McDaniel, National Grid.)

ratios comparable to its expectations for DA, National Grid acted to further solidify its reliability-performance gains. Thus, in 2007, the utility started its DA pilot program on a fast track. National Grid moved from interest in DA to DA equipment installed in the field in about a year and a half.

SELECTION CRITERIA

National Grid decided to use the system average interruption duration index (SAIDI) as its measure for reliability performance, because SAIDI incorporates both customers interrupted and interruption duration in the statistic. National Grid wanted rapid change, so it wasn't interested in the risk associated with unproven technology. Serial number one of anything was not acceptable for a pilot that, in addition to growing the utility's corporate understanding, had to deliver reliability improvement on day one. National Grid also wanted visibility for its dispatchers and needed the operations staff to quickly accept any new equipment placed in service.

To identify which distribution feeders should be automated, the following criteria were established:

- The feeder had to have one or more existing manual tie points. National Grid wanted quick wins and was not prepared for the time it would take to create new ties. Of course, as DA

matures on the system, the utility will eliminate this criterion.

- Existing ties to alternate feeders had to have reserve capacity in excess of 50 A during peak times. This would mean there would be even more capability during off-peak periods.

- The feeder had to have experienced interruptions on the primary within the last four years. This would ensure the utility was addressing its reliability issues with the pilot and that the pilot would be challenged to perform.

Using these criteria, National Grid identified 290 feeders as candidates for DA. This list was prioritized using dollars per change in customer minutes interrupted (CMI is proportional to SAIDI when the number of customers served is stable).

Estimating the cost was easy. For material cost, National Grid obtained price estimates from vendors and then added in labor for installation. To estimate the reliability value the utility would obtain through DA implementation, an ideal feeder was assumed for the first pass. Assuming an even distribution of customers and an even distribution of interruption causes along a feeder would result in a theoretical maximum value of a 25% reduction in CMI. National Grid realized reality would impact this figure, but for the time being, it applied this factor to the historical four-year average CMI incurred by each feeder. As the utility gains experience, it will adjust this factor for future evaluations.

National Grid focused the subtransmission review in its New York territory. Circuits with more than 10 miles (16 km)

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In this 15-kV recloser installation, note the communications antenna on the pole that enables two-way communication. (Photography by John McDaniel, National Grid.)

between circuits were considered because distances less than that would be very short exposure at this level in the system. Issues on short line exposures are usually best handled using root-cause mitigation methods. National Grid also added to the list any repeat offenders from an annual review. The list of potential feeder candidates reached 17 circuits.

National Grid then prioritized these circuits based on expected reliability improvement using a similar process as that used for the distribution feeder selection. As a final filter, the utility eliminated circuits where major remediation was in progress or budgeted. This work would improve the reliability

performance of these circuits; thus, there would be no benefit to adding DA to them at that time.

PILOT CIRCUITS

Six distribution feeders and two subtransmission lines were selected for the DA pilot. An additional four subtransmission lines were selected for a reduced implementation that would allow the utility to test the communications in very difficult terrain while not overburdening the pilot workforce.

All of the noted circuits would employ distributed intelligence for the control scheme. Another four distribution circuits were selected for a centralized intelligence control scheme. As the pilot progressed, the centralized scheme encountered issues that slowed its progress, which were not related to the technology. National Grid decided to place those issues on hold and continue with the rest of the pilot. These feeders and alternative technologies will be revisited as part of the utility's Smart Grid pilot.

The circuits selected for the DA pilot are as follows:

- Duguid 26551, 26552 and 26553 (all are 15 kV)
- Bridgeport 16852, 16853 and 16854 (all are 15 kV)
- Boonville-Lowville 22 line (23 kV)
- Lighthouse Hill-Mallory 22 line (35 kV)
- Chestertown-Schroon Lake 3 line (35 kV)
- Battenkill-Cement Mountain 5 line (35 kV)
- Cement Mountain-Cambridge 2 line (35 kV)

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● Cambridge-Hoosick 3 line (35 kV)

The distribution circuits are highlighted in Fig. 2. In addition to the selection criteria noted previously, these feeders were in convenient locations so the pilot team could access them frequently.

TECHNOLOGY USED FOR THE PILOT

This pilot uses distributed intelligence through S&C (Chicago, Illinois, U.S.) IntelliTeam II controls. ScadaMate switches are used as well as the S&C Universal Interface Module to automate Cooper (Waukesha, Wisconsin, U.S.) reclosers with Form 6 controls.

The peer-to-peer communication is achieved with Cellnet’s (Norwalk, Connecticut, U.S.) UtiliNet spread-spectrum 900-MHz radios. To keep the communications consistent, National Grid also uses this same radio technology for point-to-point backhaul communication to the nearest points for uplink to the utility’s existing energy management system (EMS).

These uplink points are in substations already enabled with EMS, which is a SCADA system principally for transmission and substation control. By uplinking to EMS, National Grid was able to bring SCADA capability of the DA devices to its control centers. In addition, all data (some 86 points per device) was brought back to a central database warehouse.

Table 1 lists the hardware used in this pilot. National Grid used far more repeater radios than anticipated because the severe terrain (elevation changes and heavy long-needle pine forestation) blocked the 900-MHz signals. Despite this, the project flow went relatively smoothly because the utility had anticipated this issue. Therefore, it had included a radio field survey in addition to the typical GIS analysis. Table 2 provides information about the comparison of the original pilot cost estimate with the actual cost. The actual total pilot cost is just under the original estimate.

HOW TO MEASURE SUCCESS

The principal subtransmission circuits have been operating since January 2009 and the distribution circuit devices are about to be activated. For the subtransmission, National Grid is experiencing better-than-expected reliability improvement and the costs are meeting expectations.

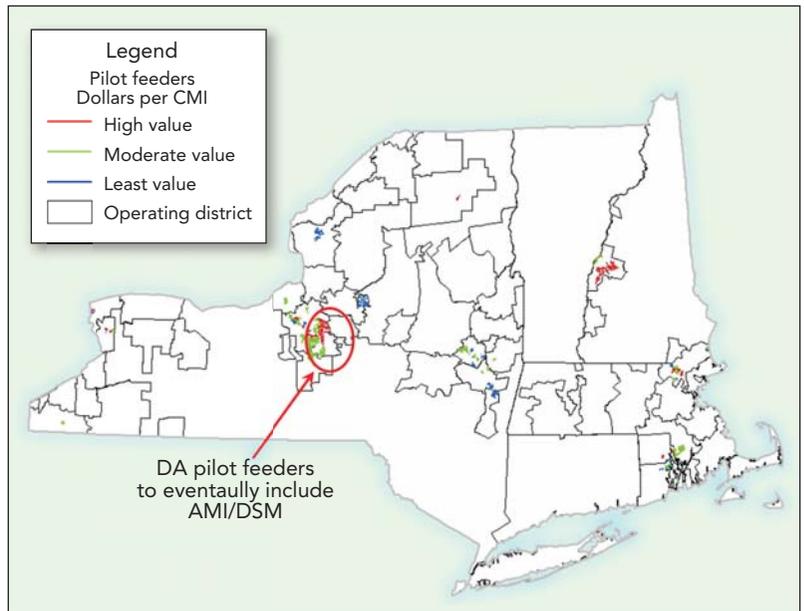


Fig. 2. DA screening for pilot opportunities shows high value cluster selected for DA pilot area.

Table 1. Hardware used in this pilot by circuit.

Circuit	Voltage	Number of reclosers	Number of ScadaMate switches	Number of ScadaMate tie points	Number of radios	Number of teams
Booneville–Lowville 22	23 kV	0	2	1	9	2
Lighthouse Hill–Mallory 22	35 kV	0	5	1	21	5
Chestertown–Schroon Lake 3	35 kV	1	0	0	8	0
Battenkill–Cement Mountain 5	35 kV	0	1	0	4	0
Cement Mountain–Cambridge 2	35 kV	0	1	0	4	0
Cambridge–Hoosick 3	35 kV	0	1	0	12	0
Duguid 26551	15 kV	3	1	2	***	4
Duguid 26552	15 kV	2	1	2	***	3
Duguid 26553	15 kV	0	1	1*	***	1
Duguid–Dewitt for back haul	—	0	0	0	***	0
Bridgeport 16852	15 kV	2	1	2	****	3
Bridgeport 16853	15 kV	2	1	3*	****	3
Bridgeport 16854	15 kV	1	1	2**	****	2
Total		11	16	9	153	23

* Counted in another feeder; ** One counted on another feeder; *** 48 radios for Duguid; **** 47 radios for Bridgeport.

Table 2. Pilot cost information (original vs. actual).

	Per unit cost without adders	Original unit cost estimate without adders	Percent of actual spend compared to original estimate
Dist-Central	\$68,125.59	\$86,787.00	78%
Subt-Central	\$69,668.84	\$61,762.00	113%

One might ask how the utility bettered its starting assumptions, which assumed theoretical best values. Two factors provided this delta. First, the utility had assumed a perfectly even distribution of load and root causes. Obviously, reality is not so



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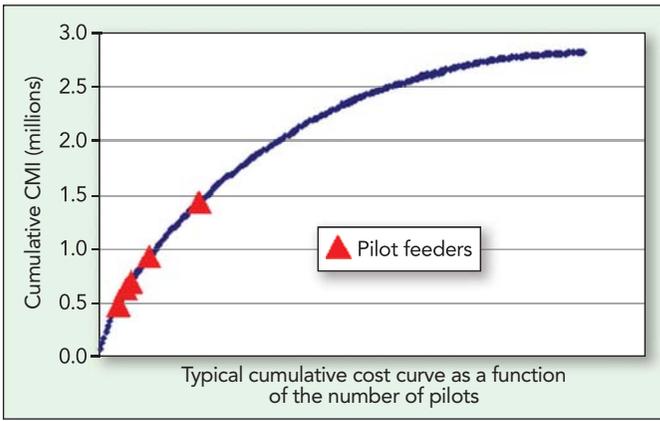


Fig. 3. Cumulative cost-benefit curve for DA pilots. This will refine as more information is gathered from the pilot installations.

evenhanded. The utility's final filter was to pass the theoretical results by engineers who were familiar with the circuits and allow them to adjust DA-controlled device locations based on their knowledge of root-cause hot spots. These engineers also adjusted based on actual customer locations rather than the assumed even distribution.

These two factors resulted in an improved performance above the model expectations. As GIS data becomes more targeted, National Grid will be able to add this sophistication directly into the modeling process.

The utility has estimated significant reliability improve-

ment. The reduction of customers interrupted is estimated at 1460 for the pilot distribution feeders and 16,000 for the sub-transmission circuits. (Customers interrupted is proportional to the system average interruption frequency index [SAIFI]). The CMI reduction is estimated to be 164,000 for the pilot distribution circuits and 346,000 for the subtransmission circuits. (CMI is proportional to SAIDI.)

National Grid has achieved about one-third of its subtransmission annual expected improvements in the first three months of operation. With costs on budget, the resulting benefit-cost ratios are better than the anticipated US\$10/ΔCMI to \$12/ΔCMI. The pilot feeders are depicted on the cost-benefit curve in Fig. 3. While certainly not inexpensive, the benefit for the incremental cost is within the ballpark of other mitigation measures.

Moving to a production mode will require careful discernment to ensure the lowest-cost mitigation is used. Sometimes this will be attacking the root cause as National Grid has historically done; other times it will be a DA implementation or a combination of the new and older approaches. DA is proving to be not a panacea but a very useful tool to add to the tool bag of options.

NEXT STEPS

National Grid will complete the activation of the remaining units at the distribution level and then monitor the performance of the pilot systems. When sufficient operating experience has been documented, a summary report will be created.

The utility is beginning a pilot for the Smart Grid, which will have a self-healing portion that is informed by the DA pilot. Integration of many facets within the Smart Grid will involve changes to the approach used in the DA pilot in order to maximize value for such things as a common communication system. These changes will not alter the underlying value relationships determined through the DA pilot.

With a thorough understanding of the cost and benefit for DA, National Grid will be in a position to choose the most-successful reliability options with minimal-cost impact for its customers. The utility is gaining firsthand knowledge through the DA pilot and also improving its reliability performance. Results to date are better than expected. **TDW**

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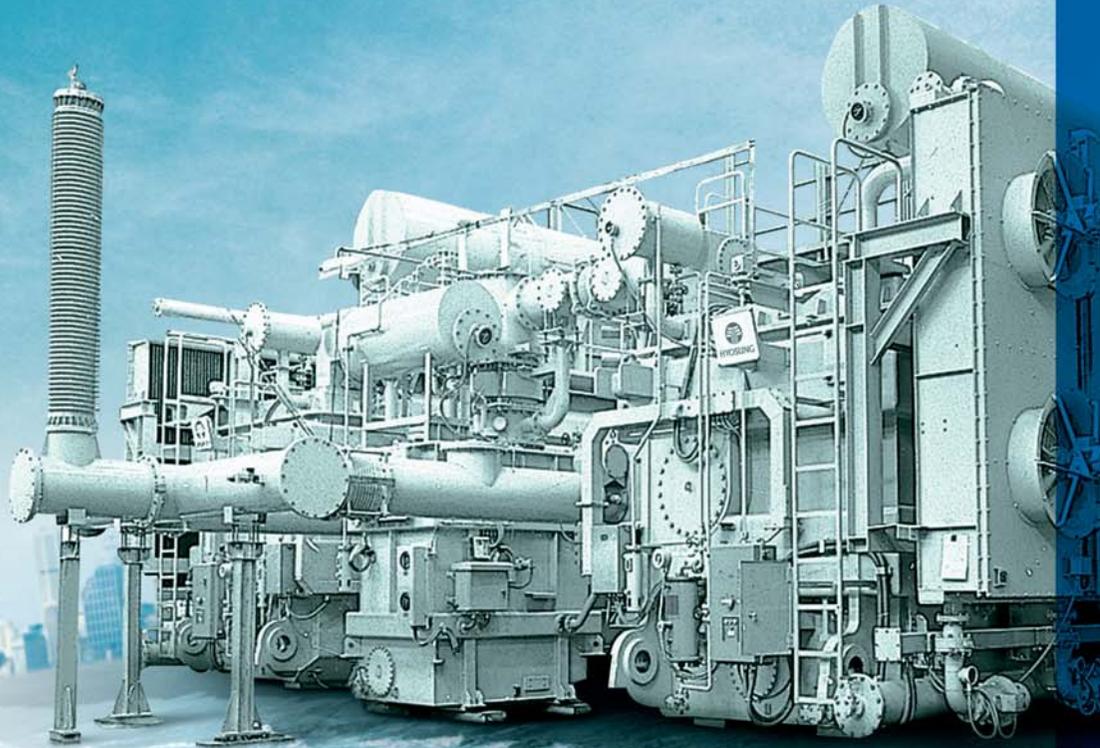
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Spatial Data Accuracy

EnergyAustralia's digital cadastre upgrade project resolves safety issues, streamlines data integration and improves efficiencies in network asset management.

By **Craig Hersant**, *EnergyAustralia*, and **Justin Eldridge**, *we-do-IT*

UNACCEPTABLE POSITIONAL INACCURACIES IN ENERGYAUSTRALIA'S DIGITAL CADASTRE DATABASE (DCDB) have caused safety concerns and hampered the utility's attempts to improve the efficiency of its geographic information system (GIS) processes.

These inaccuracies also have been an impediment to planning, maintenance and construction activities, while exposing the business to risk, particularly where the GIS products have

to be integrated with the GPS data or ortho photography.

Australia's largest distribution network, which supplies power to more than 1.5 million customers, is operated by Sydney-based EnergyAustralia. The utility's service area spans 22,000 sq km (8494 sq mi) and ranges from Waterfall in south Sydney to the Upper Hunter Valley in the north. EnergyAustralia's network includes more than 500,000 poles, nearly 28,000 substations and kiosks, and about 46,000 km (28,583 miles) of underground cable and overhead line. The area is also administered by more than 40 local government authorities, and the utility's related DCDB contains almost 1.3 million land parcels.



This map of EnergyAustralia's supply area shows the regions of overlap with Sydney Water and Hunter Water.

IMPROVING THE ACCURACY

When EnergyAustralia decided to tackle the challenge of improving the accuracy of its DCDB, it planned the project in three stages:

1. EnergyAustralia leveraged work already completed by Sydney Water and Hunter Water, two other utilities in EnergyAustralia's service area, by adopting those utilities' DCDBs and realigning the position of network assets to the new land base.

2. A spatial adjustment of the land base for the Central Coast was completed as part of a cooperative project between EnergyAustralia, the Land and Property Information New South Wales (LPI NSW) division, and the two local government authorities in that region.

3. Commenced in July 2008, once complete, the final stage will address accuracy concerns in Hunter Valley. This stage will follow a similar approach to that taken in the Central Coast and is also expected to deliver significant benefits for all participants.

The scale of this undertaking — including the significant level of input needed between various government agencies and private industry — required a cooperative approach

to improving the accuracy of the land base.

BUSINESS IMPERATIVES FOR ACTION

Demand for spatial accuracy in GIS has continued to increase as improvements in technology have led to new data applications and changing expectations of stakeholders. For EnergyAustralia, the misalignment of the land base was having a detrimental impact on operations in many business areas. Five primary drivers for this project were outlined:

1. Improve safety for EnergyAustralia staff and the general public.
2. Reduce the effort involved in integrating accurate survey data with a less-accurate DCDB.
3. Minimise potential legal issues arising from spatial inaccuracies.
4. Reduce delays in decision making due to a lack of confidence in the accuracy of the GIS.
5. Capitalise on opportunities to employ automated data-capture methods.



Current land base parcel locations in blue overlaid on orthorectified imagery. This illustration highlights the magnitude of the discrepancy in some parts of the EnergyAustralia supply area.

While many benefits accrued as a result of this project, the safety of staff and third parties remained the primary driver. The safety of maintenance crews can depend on the quality

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Shift vectors created from aerial photography. (Inset) GPS being used to capture the position of a new joint.

of information stored on the location of underground assets. The general public also relies on accurate information from services such as Australia's Dial Before You Dig program for safe and efficient development of the built environment. Any positional error greater than 0.5 m (1.64 ft) may compromise the safety of staff and the general public when work is being carried out on, or adjacent to, the electrical network.

Improving the efficiency with which other spatial data can be integrated with the GIS was another key objective for this project. Increasing the use of GPS has the potential to significantly improve the efficiency with which network maintenance operations are conducted. However, any gains are limited by the lack of existing accurate spatial information to which the GPS measurements can be related.

There is also an increasing requirement to integrate accurate spatial data from other sources and in different formats with the GIS. As EnergyAustralia worked through the data and technology issues, spatial mismatching between data sets emerged as a significant problem.

Increased spatial accuracy will reduce the effort required to relocate assets and minimise the costs associated with engineering design, construction and maintenance. It also will reduce delays in decision making, resulting from a lack of confidence in the GIS, and minimise legal exposure arising from problems created by spatial inaccuracies.

THE COOPERATIVE PROJECT

In 2006, EnergyAustralia initiated a cooperative arrangement with the Gosford City Council, Wyong City Council and LPI NSW to use accepted survey methods to perform a spatial adjustment of the Central Coast region. The objective was to improve the accuracy of property boundaries to less than 3 m (10 ft) in rural areas and 0.3 m (1 ft) in urban areas.

Each one of these agencies held a different piece of the

source material puzzle, so it would have been impossible for any one of them to complete this type of undertaking on their own. Bringing all of the elements together in a project of this scale demanded strong leadership and a unique approach.

EnergyAustralia managed the project, collating available source data and coordinating the efforts of all parties to the agreement. EnergyAustralia funded the spatial adjustment work, which was outsourced to a Melbourne, Australia-based company called we-do-IT.

LPI NSW contributed source data, which included access to the NSW survey control database, high-resolution orthorectified digital imagery and traverse data where available in the area.

The local government authorities also provided critical source material, including the most up-to-date deposited

plans (DPs) and a significant number of survey-accurate land parcels that had been adjusted during a previous project to upgrade the DCDB.

A critical part of the project was the development of a relationship between all parties for the maintenance of the DCDB. The rate of growth across the Central Coast, one of the fastest-growing regions in NSW, has long presented a significant problem for the effective maintenance of the DCDB. This project enabled each organisation to operate under a memorandum of agreement for the sharing of updated information and allows for the ongoing maintenance of accurate and current spatial information.

THE ADJUSTMENT PROCESS

When the available source data had been collected and evaluated, EnergyAustralia worked with we-do-IT to develop a process for adjusting the land base to its new position. This was a four-step process:

1. *Identify the magnitude of shift required.* Aerial photography, original survey information and GPS control points were used to identify the magnitude of shift required in the DCDB. Orthorectified aerial photography, which allowed identification of parcel corners on the land base and the imagery, was used to generate vectors describing the required shift.

Unfortunately, this technique was not viable in areas with extensive tree cover or poorly marked boundary lines. In these areas, original survey information, combined with GPS coordinates for permanent marks, was used. This process required the identification of permanent marks for which accurate coordinates were available and using these to calculate accurate coordinates for vertices on the land parcels.

2. *Constrain the shape of the land base parcels.* The shift to the land base was not uniform across the supply area. This variation was due to original mapping scale accuracy limitations,

anomalies in the land base, and changes in the quality and accuracy of the survey information. When shifting the land base, there were also specific geometric properties such as right angles that had to be maintained. These were identified and listed as constraints on the adjustment process. By applying the constraints, it was possible to maintain the existing shape of the land base while applying the shift.

3. *Calculate the new location for the land base.* The calculation for the new location of the land base took into account the shift to be applied and the constraints that had been specified on the shape of the land base. The shifts have the highest priority, and the constraints have progressively lower priority in the adjustment process. The adjustment process was able to balance these requirements using least squares, which aimed to minimise the impact on the specified constraint while applying the magnitude of shift.

4. *Perform quality assurance and quality checking.* The adjustment process produced statistics that could be used to identify

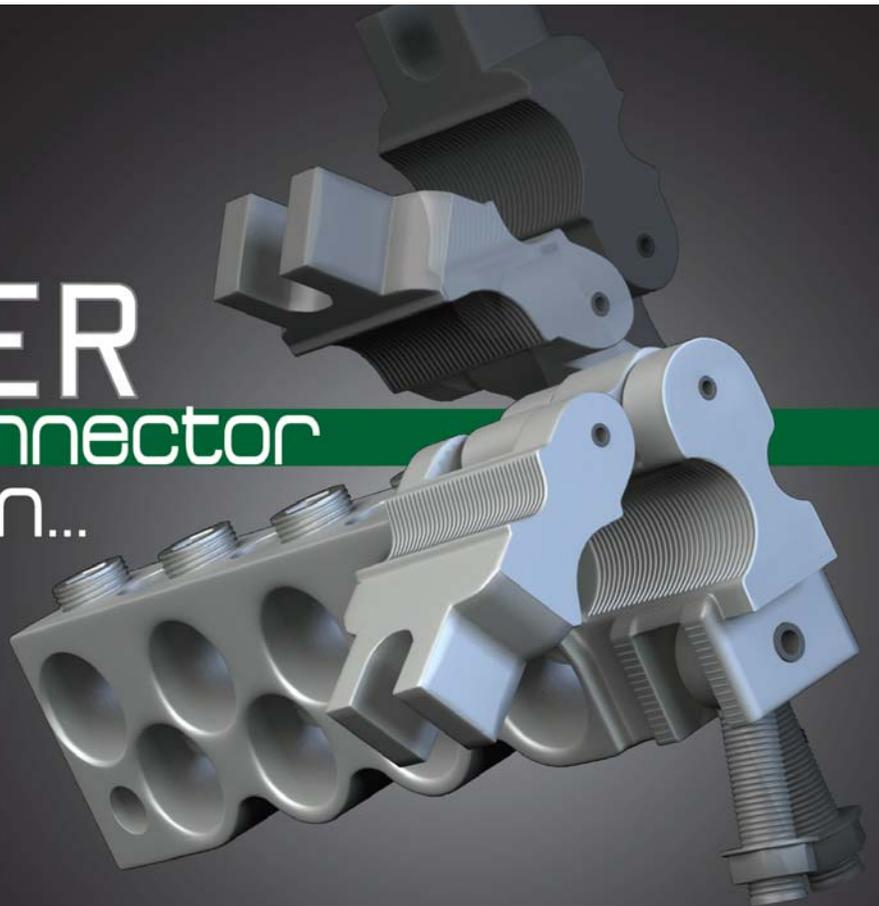


The land base before (red) and after (blue) the adjustment process.

shifts that were in error, perhaps due to a mistake in the original capture process, or where a constraint could not be met, for example, where the existing land base is in error.

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- Assets updated to a more accurate location
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 - High-voltage lines — 20,806
 - Low-voltage cables — 156,690
 - Low-voltage lines — 326,285
 - Auxiliary conductors — 2919
 - Poles — 120,132
 - Pillars — 16,883.

BUSINESS BENEFITS

Improving the accuracy of the EnergyAustralia GIS land base has delivered a number of significant benefits to the business. The resolution of safety issues was the primary driver for this project, and it is estimated that over a period of five years, EnergyAustralia will accumulate a net benefit in excess of AU\$1 million (US\$0.81 million).

EnergyAustralia accuracy requirements (± 0.3 m in urban areas and ± 3 m in rural areas) have been achieved in areas where the adjustment of land base and assets has been completed. This has enabled key improvements in productivity:

- The smooth integration of data from multiple sources, including CAD files, orthorectified imagery, DPs and GPS
 - Greater efficiency in the management of network assets, including underground asset location (increasing the use of GPS), engineering design, construction, maintenance and outage management

The project has reduced the costs linked to the integration of accurate survey data, minimised legal costs associated with the provision of inaccurate data and simplified the integration of accurately recorded network assets, particularly those underground. Other intangible benefits have been realised as a result of this project:

- Reduced legal exposure for the business
- Increased usefulness of the EnergyAustralia GIS
 - Improved services to internal and external clients
 - Improved ability to share data with other organisations
 - Use of advanced field-recording technologies
 - Data not bound to the DCDB and specific application platforms.

LESSONS LEARNED

Local government, utilities and LPI NSW all have a keen interest in the creation and maintenance of an accurate and up-to-date DCDB. Significant benefits and efficiencies can be accrued through this cooperative approach.

It proved critical that data requirements and availability were determined as early as possible in the project. Where necessary, plans for the acquisition/creation of ad-



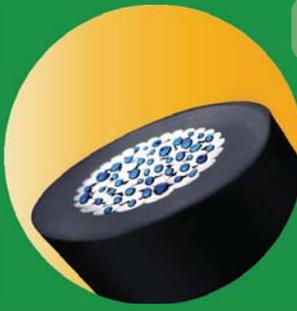
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ditional data must be fully integrated in the overall project plan.

DPs provide the most-accurate source of point information, but in rural and semi-rural areas, they are unlikely to provide sufficient density on which to base the spatial adjustment. In most areas, it was necessary to rely on aerial photography to supplement the control network.

Be aware that occupation, rather than legal boundaries, may be measured where imagery is used to generate shift vectors.

Under current arrangements, the cooperation of local government is critical in order to maintain an up-to-date cadastre. EnergyAustralia relies on local government for the maintenance of its proposed cadastral layer in the GIS. Joint endeavours require strong, focused leadership and good communication with all stakeholders.

The DCDB project has delivered significant benefits in the areas of data capture, information sharing and service delivery for EnergyAustralia, LPI NSW and the local government authorities of the Central Coast. There have been real improvements in efficiency that have reduced costs and provided more timely access to asset information critical to the operation of the business. However, perhaps the most-significant outcome was further improving safety for EnergyAustralia's maintenance staff and members of the public relying on GIS data. **TDW**

Craig Hersant (chersant@energy.com.au) was awarded his bachelor's degree with honours from the University of New South Wales (Sydney, Australia), master of defence studies from the University of Canberra (Canberra, Australia) and a MBA degree from the University of Southern Queensland (Queensland, Australia). He spent 23 years in the Australian Army, where he held a number of senior appointments in the imagery and geospatial fields and a posting in Iraq before he joined EnergyAustralia in 2006. Leading a GIS team of 140 permanent and contract staff, Hersant manages the GIS data operations for EnergyAustralia. He is a member of the Board of Surveying and Spatial Information (BOSSI) and a member of Geospatial Information & Technology Association.

Justin Eldridge (jeldridge@we-do-it.com) has dual bachelor's degrees, one with honours in geomatics, both awarded from the University of Melbourne, Australia. For the past 10 years, he has specialised in all aspects of the analysis, design and implementation of network inventory systems for telecommunication companies and utilities in Australia and New Zealand. As a result, he has gained extensive experience and understanding of business processes that must be supported and the increasing focus on accuracy of spatial information. Eldridge is a principal consultant with we-do-IT (Melbourne) and a member of Geospatial Information & Technology Association.

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Isolated Area Reliability

Georgia Power brings next-generation system protection to St. Simon's Island.

By **Jason T. Payne**, *Georgia Power Co.*

EVEN IN THE AGE OF INTELLIGENT, FAULT-DISTANCE-SENSITIVE RELAYING, ISLANDS and other isolated areas still present a major restoration hurdle because of radial taps on radial lines. Islands can be fed through several different conventions, but the fact remains that it is extremely expensive to build redundancy. And in the event of an outage, restoration efforts are usually both difficult and time consuming. To reduce the time it takes to restore power on a prominent resort island, Georgia Power Co. (Atlanta, Georgia, U.S.), a Southern Company subsidiary, has implemented new technology to assist in load restoration.

GOLDEN COAST OF GEORGIA

Heavily protected century-old oak trees decorated with Spanish moss line the streets and yards of every lot on St. Simon's Island, Georgia, and the transmission right-of-way is no exception. Local ordinances prohibit the removal of any oak tree on the island without approval, and trimming is heavily discouraged. Most outages on the high-profile line are caused by tree contacts in medium to high winds. The beautiful moss-covered oaks, which live and grow within the transmission right-of-way, wrap their branches around the distribution and transmission circuits.

Fortunately for Georgia Power, the hurricane activity has

been very forgiving to the Golden Coast of Georgia over the past few decades. The coast has had several brushes with violent hurricanes, direct hits from tropical storms and the occasional tornado. Hurricane season in Georgia is generally mild compared to that of neighboring states, but in anticipation of a large-scale storm, Georgia Power has installed LineTracker technology from GridSense (West Sacramento, California, U.S.) on a 115-kV line on St. Simon's Island. The Smart Grid device records and transmits information from the longest and most-exposed line tap on the island.

LineTracker is a simple-to-install device that clamps onto bare transmission or distribution conductors up to 1.33 inches (34 mm) in diameter at voltages up to 138 kV. Installation does not require the line to be de-energized, and these devices can be installed and removed using hot-stick or live-line methods in a short amount of time. Three spring-loaded fingers hold the LineTracker securely to the conductor, and facilitate the voltage and conductor temperature measurements. The spring-loaded fingers automatically close, and the Rogowski coil circuit connection is completed when the LineTracker presses against the conductor and a safety mechanism is manually engaged.

The devices are unobtrusive, versatile and self-powered by a solar panel. They can be used in practically any location on



The complete installation with the inconspicuous LineTrackers hanging on the conductors to the left of the switch.

revolutionize the power grid. Additional uses include transmission monitoring, line capacity ratings, troubleshooting, capacity planning and asset optimization. Currently, the LineTracker devices are configured to monitor and transmit:

- Event types (momentary, sustained, power restoration and fault current detected)
- Voltage presence
- Current (real-time current in addition to pre- and post-fault current)
- Temperature (ambient and conductor surface temperature)
- DataPAC and LineTracker battery voltage.

Twelve-cycle fault waveforms (current and relative voltage) and load profiles (current, power factor and phase angle) are also available through the DNP3 protocol. It is highly recommended the LineTracker devices be installed on the load (normally energized) side of the switch, so they not only indicate fault currently flowing through the switch, but also verify that voltage is present on the load side of the switch. This confirms the line leading to the switch is in service, even with the switch in the open position because of a downstream fault.

SMART SWITCHING AND RATINGS

Georgia Power also has been experimenting with the expansion of this technology in the area of real-time line capacity rating, or dynamic line capacity rating, which is the real-time rating of a conductor due to environmental conditions (i.e., wind, ambient temperature, rain, sun, etc.). This would



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the system, such as substations, reclosers, switches, underground risers and taps. In the St. Simon's Island pilot installation, the device is mounted in the close vicinity of a remote-controlled, motor-operated switch, primarily to transmit fault data back to Georgia Power's control center in Atlanta.

DATA IS GOLDEN, TOO

The LineTracker device transmits real-time information through a license-free radio frequency to a receiver referred to as a DataPAC (pole-attached collator). In turn, the DataPAC can communicate through a RS-232 serial port, Ethernet, modem (cellular, landline or satellite) or utility radio. For the St. Simon's Island installation, the external serial port is connected to an existing remote terminal unit (RTU) associated

with the motor-operated switch. Programming and reporting are dependent on the type of RTU used. This particular motor operator is outfitted with a Telvent (Madrid, Spain) SAGE 1330, and all available information is transmitted to the control center. In the future, only application-specific in-

formation may be transmitted, but for this pilot project, it is beneficial to see all the data.

The receiver has an internal battery and can be powered by a 55-Vac to 600-Vac, or 13.8-Vdc, solar panel. A local ac power source was readily available at the subject switch mechanism,

LINE MONITOR ALARMS			
BATTERY VOLTAGE (POLE MOUNTED MASTER)		13.60 VLT-DC	
<input type="checkbox"/> LOSS OF COMMUNICATIONS WITH THE MONITOR			
LINE MONITOR ALARMS	PHASE 1	PHASE 2	PHASE 3
EVENT TYPE - SHORT INTERRUPTION	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EVENT TYPE - LONG INTERRUPTION	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EVENT TYPE - ON THE FAULT PATH	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EVENT TYPE - POWER RETURN	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PRE TRIGGER POWER STATUS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
POST TRIGGER POWER STATUS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BATTERY VOLTAGE	2.24 VLT-DC	2.08 VLT-DC	2.08 VLT-DC
VSSENSOR STATIC	3200 V	164800 V	11200 V
EVENT TRIGGER CURRENT	174.4 A	252.8 A	422.4 A
PRE TRIGGER CURRENT	32.0 A	38.4 A	36.8 A
POST TRIGGER CURRENT	32.0 A	35.2 A	32.0 A
LOAD LOG CURRENT	38.4 A	43.2 A	40.0 A
LINE FREQUENCY	0.0 HZ	0.0 HZ	0.0 HZ
POWER FACTOR	0.000 PF	0.000 PF	0.000 PF
PHASE ANGLE	0.0 DEG	0.0 DEG	0.0 DEG
AMBIENT TEMP (DEG C)	7.36 DEG(C)	8.32 DEG(C)	8.80 DEG(C)
CONDUCTOR TEMP (DEG C)	10.88 DEG(C)	10.38 DEG(C)	7.04 DEG(C)

This screen shot of the control center screen in Atlanta shows the real-time information as reported from the Linetrackers in St. Simon's Island.



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Customers Benefit from Single-Phase Reclosing

Can we prevent customers served on phase A from being affected by a fault on phase C?

By **Julio Romero Agüero**, *Quanta Technology*, and **Laura Whittington**, *Commonwealth Edison*

POTENTIAL RELIABILITY BENEFITS COULD BE ACHIEVED THROUGH THE IMPLEMENTATION of single-phase reclosing and lockout in distribution feeders. However, several issues and misconceptions regarding potential problems must be addressed first.

Despite the potential problems, the improvement to system average interruption duration index (SAIDI) is real and demands attention.

FAULT PROTECTION

Historically, the fault protection of distribution feeders has been accomplished with protective devices such as fuses and reclosers, which are applied using one of two overcurrent-protection philosophies:

- *Fuse blowing.* Reclosers and fuses are coordinated so that both temporary and permanent faults are isolated by blowing the fuse immediately upstream of the fault. This is also known as fuse clearing.

- *Fuse saving.* Reclosers and fuses are coordinated to allow temporary faults to self-extinguish during the reclosing intervals. Only permanent faults are isolated by blowing the upstream fuse.

Typically, three-phase reclosers are installed in main trunks and sometimes in long or highly loaded three-phase laterals. Single-phase reclosers are installed in single-phase and two-phase laterals and sometimes in three-phase laterals. Modern three-phase reclosers, such as the one in Fig. 1, are designed to allow the reclosing and lockout of individual phases. Similarly, modern single-phase reclosers can be controlled to reclose and lockout all phases simultaneously.

RECLOSING SCHEMES

Reclosers are fundamental to improving the reliability of distribution systems. However, independently of the fault's nature (temporary or sustained and single phase, two phase or three phase), the reclosing attempts and lockout operation of a conventional three-phase recloser affect all three phases of the distribution system, causing momentary or sustained interruptions to all downstream customers.

This sort of three-phase reclosing and lockout is not optimal from the point of view of customer reliability indices. Why do customers served by phase A of a feeder have to be affected by a fault that occurs in phase C of the feeder? This criticism and the availability of modern reclosers have driven the implementation of other reclosing schemes for



Fig. 1. A typical three-phase recloser installed on a main feeder can operate all three phases simultaneously, or allow operation and lockout of individual phases.

improving the reliability of the distribution system.

Modern reclosers are capable of providing the classic and most-common protection scheme used by utilities. In this scheme, all phases trip and reclose during the reclosing cycle, and all phases lock out if the fault is permanent.

A second functionality is available providing single-phase reclosing and three-phase lockout. In this mode, only the faulted phase trips and recloses. Lockout, if required, affects all phases. This scheme is similar to that used for transmission lines, and it is starting to become more popular for distribution applications.

A third scheme involves both single-phase reclosing and single-phase lockout. This is the most controversial and least-common application of modern reclosers. Nevertheless, some utilities are starting to implement this scheme, which can lead to significant reliability benefits.

ISSUES AND CONCERNS

The implementation of single-phase reclosing is controversial for several reasons. One is the possible impact of this sort of system operation on the equipment, especially the impact of losing one phase for those customers using three-phase motors. While this can be a valid concern, it is worth noting that the protection against the loss of one phase is part of a typical protection scheme for three-phase motors. And, of course, customers are also responsible to develop protection schemes to protect their equipment.

It is also worth noting that, for decades, utilities all over the world have been installing fuses (one per phase) in three-phase laterals. In this situation, a single-phase fault causes the operation of only one fuse, producing exactly the same effect as the single-phase lockout of a recloser would produce. Similarly, it also has been a relatively common practice to install three single-phase reclosers in long three-phase lines, usually in rural areas. Many of these single-phase reclosers do not have the capability of locking out the three phases simultaneously, which leads to single-phase lockout when a permanent single-phase fault occurs downstream.

Another concern is related to the unbalanced protection of the feeder, specifically with the operation of the ground overcurrent relay. When only

one phase of a recloser locks out, it creates an unbalance that can cause the operation of the ground overcurrent relay. This can be overcome in many situations by modifying the relay settings to increase the tolerance for higher unbalance or by limiting the application of single-phase reclosing to sections of the feeder where the unbalance is not significant enough to cause the operation of the ground overcurrent relay.

Additionally, a potential issue to consider, according to the regulations of some states in the United States, is that the loss of service in at least one phase of a three-phase customer is considered a sustained interruption for reliability purposes.

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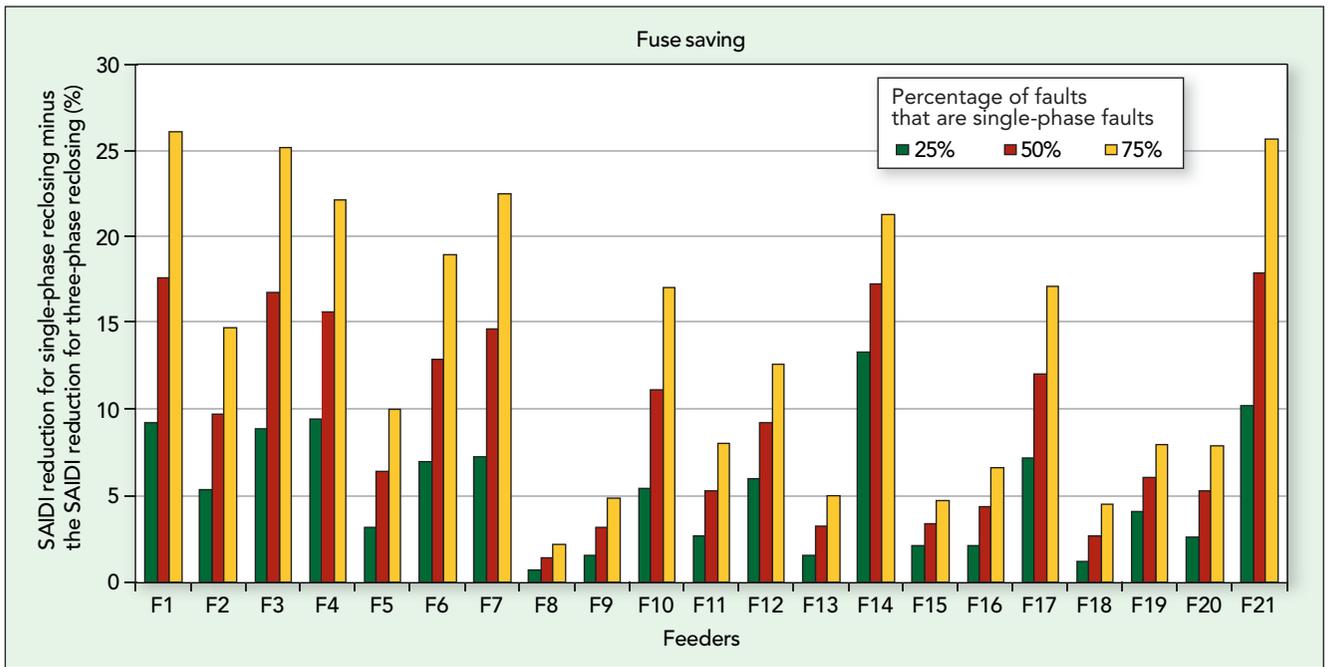


Fig. 2. Fuse saving is used: Difference in SAIDI reduction achieved through single-phase reclosing (1P) and three-phase reclosing (3P).

While this is also a valid argument, it is worth noting that if the loss of service was due to a fault, the three-phase customer would be affected by an interruption independent of the reclosing scheme being used. Furthermore, if three-phase reclosing were used, not only the three-phase customers would be affected, but so would all the other customers located downstream of the recloser. However, if single-phase reclosing were used, only those customers served by the faulted phase (including the three-phase customers) would be interrupted and counted for reliability purposes.

Other concerns are related to backfeed, ferroresonance and the potential interaction of reclosers and distributed generation. These issues are analyzed on a case-by-case basis.

RELIABILITY BENEFITS

In order to show the advantages and reliability benefits of single-phase reclosing, a comprehensive study was performed for a typical distribution system. This study analyzed the impact of the installation of reclosers for improving the reliability (SAIDI) of the distribution system. The system consists of 36 feeders (12.5 kV), with a total of 36,476 customers, and has the typical four-wire multi-grounded layout used in the United States, with single-phase and three-phase distribution transformers. The study estimated and compared the reliability benefits due to the installation of 24 reclosers in 21 feeders for both protection philosophies — fuse saving and fuse blowing — and two reclosing schemes — single phase and three phase.

The reliability benefits were estimated using a predictive reliability model (PRM) developed using the SynerGEE Electric solution from GL (Hamburg, Germany). The PRM was built from a typical power flow model. The power flow model included all the data about the connectivity of the system, distribution system components and distribution transformer

loads. The PRM was built by allocating customers to all distribution transformers and assigning reliability parameters, such as failure rates and mean times to repair (MTTR), to all distribution system components (overhead and underground lines, protective and switching devices, and distribution equipment).

The reliability parameters of the distribution equipment and protective and switching devices were assigned using data available from several sources such as manufacturers, specialized literature and industry data. The reliability parameters of overhead and underground lines were calibrated using historical reliability and outage data for the last five years. These parameters were calibrated in such a way that the reliability indices, SAIDI and system average interruption frequency index (SAIFI), calculated by the PRM match the average value of the historical reliability indices from the last five years.

The historical reliability indices were calculated per the IEEE 2.5 Beta Method for major event exclusion. Within the model limitations, the calibrated PRM represents the current reliability of the distribution system. The calibrated PRM is the “base model” for reliability analysis, and the calibrated reliability indices are the “base reliability” of the system.

The PRM simulates faults in all components according to their respective failure rates and MTTR, and then it calculates the corresponding reliability indices (SAIDI and SAIFI). Therefore, the benefits of installing a set of reclosers can be estimated by comparing the reliability indices calculated by the PRM before and after installing the reclosers. During the simulations and analyses performed in this study, all the reclosers were operated using three-phase reclosing or single-phase reclosing. The reclosers were installed in strategic locations on the system in order to try to increase their reliability benefits and effectiveness. Reliability indices were calculated for all combinations of fuse saving and fuse blowing protec-



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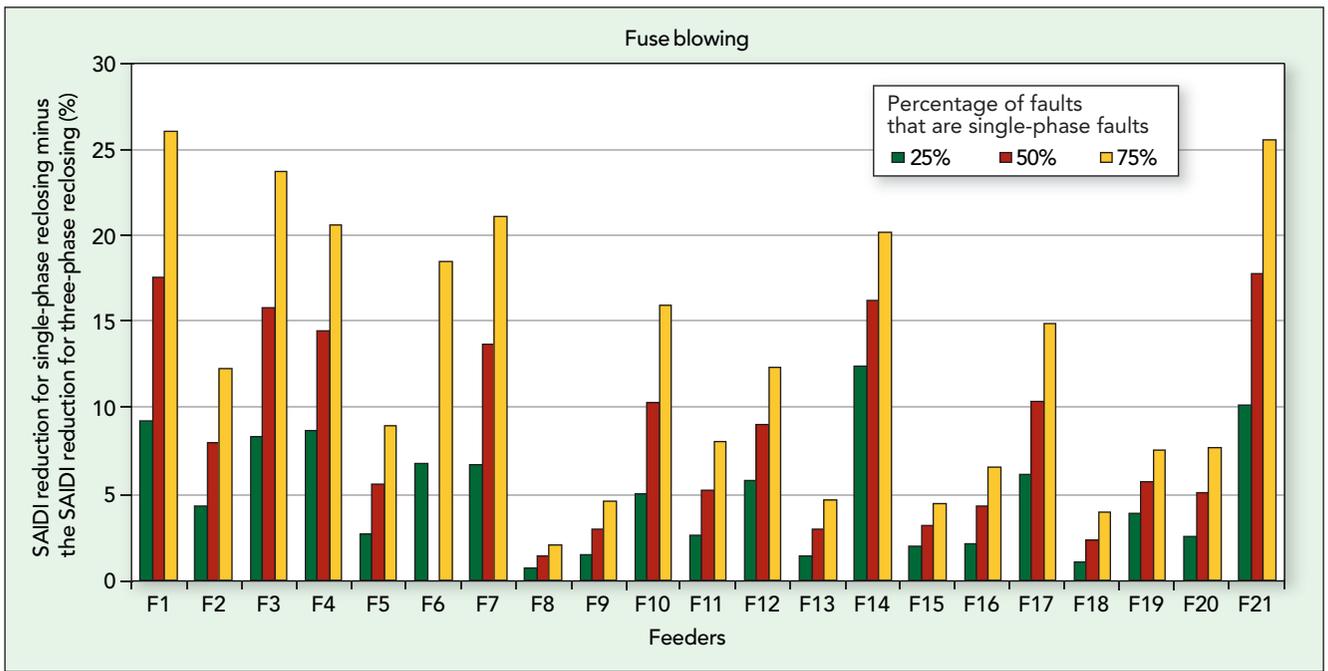


Fig. 3. Fuse blowing is used: Difference in SAIDI reduction achieved through single-phase reclosing (1P) and three-phase reclosing (3P).

tion philosophies and for both single-phase and three-phase reclosing and lockout.

SINGLE-PHASE FAULT COMPONENT

One variable that influences the effectiveness of single-phase reclosing is the percentage of single-phase faults that occur in the distribution system. For each condition, results were calculated for three different percentages of single-phase faults: 25%, 50% and 75%. These percentages indicate the ratio of faults that are single phase with respect to the total number of faults in the system.

This variable will have a significant influence. For instance, if all faults that occur in the distribution system were three phase, then both single-phase reclosing and three-phase reclosing would have the same impact on reliability. Nevertheless, since most faults in the distribution system are typically single phase, it is expected that the reliability benefits of single-phase reclosing are significant.

SIMULATION RESULTS

The PRM simulation results show that single-phase reclosing achieves a higher reduction in SAIDI than three-phase reclosing, and that this reduction increases as the percentage of single-phase faults increases from 25% to 75%. This is true for both fuse-saving and fuse-blowing protection philosophies.

These results are explicitly shown in Fig. 2, which presents a plot of the differences between the SAIDI reduction attained by single-phase reclosing and three-phase reclosing. The plots show that for both overcurrent protection philosophies, single-phase reclosing achieves larger improvements in SAIDI than three-phase reclosing.

This shows that the difference in SAIDI reduction attained by both reclosing schemes can be notable for some feeders. For instance, if 75% of faults in feeder F1 were single phase

and fuse saving were used, the SAIDI reduction attained by single-phase reclosing would be 33% with respect to the base case. On the other side, the SAIDI reduction achieved by three-phase reclosing would only be 6%, which would lead to a significant difference of about 27% between both reclosing schemes. This is the value shown in Fig. 3.

These results demonstrate the notable potential reliability benefits that can be attained by implementing a single-phase reclosing scheme. These noteworthy benefits justify considering and further analyzing the possibility of implementing single-phase reclosing as part of a standard approach for improving the reliability of distribution feeders. For instance, this application is particularly attractive for feeders with mostly residential customers, where problems related with three-phase motor loads are not a concern. TDW

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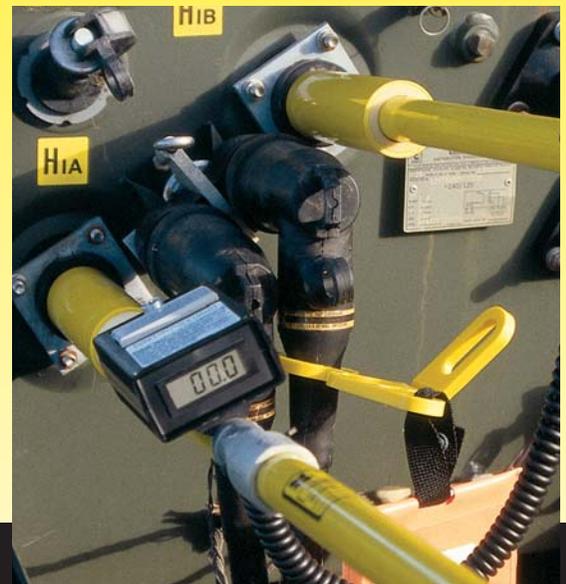
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2009 U.S. Renewable Energy Wall Map

The 2009 U.S. Renewable Energy Wall Map is available from Ventyx. This fifth edition of the popular map has been updated to show the status of renewable energy in the U.S. electric generation mix as of Jan. 1, 2009, and is the most comprehensive view of this rapidly expanding sector of the U.S. energy industry.

Using data from the Ventyx Velocity Suite energy intelligence solution, the full-color map displays more than 1100 existing plants and almost 750 proposed power plants fueled by renewable sources such as wind, biomass, geothermal, solar and tidal power. The map clearly shows that wind power is still the lion's share of renewable projects, with an operating and planned increase of 38% and 74%, respectively, over the past 12 months. Conversely, installed biomass capacity has dropped 26% and planned by 64%. Solar and geothermal data reflect increases of about 5% each. Because all of these projects require a grid-connection, the map also identifies more than 40,000 miles (64,374 km) of proposed transmission lines and nearly 400 substation projects currently on the drawing board.

Rendered for Ventyx by Bolder Geographics, the 2009 U.S. Renewable Energy Wall Map measures 48 inches by 92 inches (1219 mm by 2337 mm) and shows existing and planned renewable facilities, transmission lines (existing and proposed), conventional plants, wind resource measurements, solar and geothermal resources, states, counties, cities and topography. **Ventyx | www.globalenergymaps.com**

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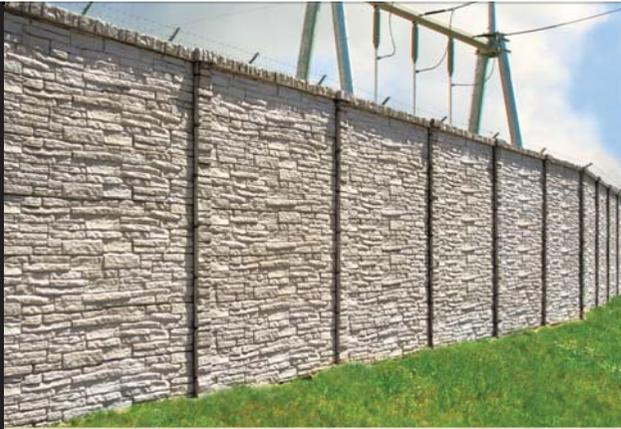
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The Fluke 289 Industrial Trending Digital Multimeter has multiple features specifically designed for industrial technicians.

The Fluke 289 has automatic safety features like ghost voltage detection, easier logging with better display for on-the-spot troubleshooting, filters for variable-frequency drive (VFD) output readings, and on-screen help. Other capabilities built into the Fluke 289 are saving, recording and TrendCapture. The Fluke 289 DMM provides the usual measurement functions, such as Vac, Vdc, ohms, capacitance, Aac and Adc. For these, the user can have the meter monitor a circuit while the technician is busy elsewhere.

The 50-W function has the ability to measure low resistances with 0.001-Ω resolution. Also, the measuring circuit uses a much higher measurement current than normal ohms functions, making low-resistance readings more accurate in high-noise environments. This safety and accuracy function clearly identifies live conductors among those showing ghost voltage, which appears on unconnected wiring in close proximity to live conductors. With a low-pass filter, users can monitor the output voltage and frequency of an adjustable-speed motor drive accurately, while rejecting the higher-frequency output voltages that often confuse lesser meters. The new "(i) info" button provides a convenient alternative to the need to carry a manual or reference card around. Just select the desired function, highlight it in the menu, and press, "(i) info" to see a brief description of the function and its use.

Fluke Corp. | www.fluke.com



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Specialty Herbicide

Dow AgroSciences' VISTA XRT specialty herbicide helps control dogfennel, lespedeza and kochia at lower use rates. Concentrated Vista XRT contains 2.8 lb (1.3 kg) of active ingredient, resulting in less container handling and more acres treated per gallon along utility lines.

The new high-load formulation of Vista XRT provides control of kochia, including ALS- and dicamba-resistant biotypes. When used in combination with DMA 4 IVM, GARLON or TORDON specialty herbicides, Vista XRT also delivers consistent broad-spectrum control to a variety of other difficult-to-control broadleaf weeds and woody plants.

Acceptable for use on rights-of-way, Vista XRT can be applied to cool- and warm-season grasses. Vista XRT handles easily, even in hot climates, and is rainfast one hour after application.

Vista XRT is formulated by using a seed oil derived from naturally occurring seed oil, a proactive measure to reduce organic compounds and eliminate the use of petroleum distillates. This benefit helps ensure compliance in states that have mandated a reduction of Volatile Organic Compound emissions.

Dow AgroSciences
www.vegetationmgmt.com

Utility Light

Engineered Products Co. (EPCO) introduces a rugged utility light that is easily installed with only a screwdriver.

EPCO's new ProSeries Utility Light features an easy-to-install Octi-Junction Box that provides extra capacity for an additional power circuit. The eight mounting brackets on the Octi-Junction Box are in line with the 1/2-inch and 3/4-inch (1.27-cm and 1.9-cm) trade-size knockouts and eliminate a 2-inch by 4-inch (5-cm by 10-cm) stub-in. An integrated junction box cover features a "captive" set screw and posi-stop detent that expedites fixture installation. Also, a nickel-plated brass screw shell resists corrosion and is recessed approximately 1 inch (2.5 cm) to accommodate high-profile compact fluorescent or incandescent lamps.

EPCO | www.engproducts.com

Transformer Protection Relay

Schweitzer Engineering Laboratories Inc. (SEL) announces wide-area-measurement-based control in a transformer relay for the first time. This enhancement to the SEL-487E Transformer Protection Relay allows it to receive IEEE C37.118 synchrophasor messages from up to two phasor measurement units, time-correlate the information and take control actions based on local and remote messages. Remote angles, currents and voltages received in the serial synchrophasor message can be combined with local measurements for basic or advanced applications.

This advanced SEL-487E Relay communications technology allows customers to:

- Trip or start generators based on system load angles
- Control tap position based on combined values
- Send alarms based on changing angles
- Apply SELOGIC control equations to time-correlated remote measurements
- Detect system separation to initiate islanding control.

Schweitzer Engineering Laboratories Inc. | www.selinc.com



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Fiber-Optic Visual Fault Locator



Ripley introduces the Fiber Optic Visual Fault Locator (FO-VFL). The slim pen-style 650-nm red visible laser diode fault locator for single and multimode fiber is designed for field personnel who need an efficient and economical tool for fiber tracing, fiber routing and continuity checking in an optical network, during and after installation.

The pen detects fiber breaks, fiber leaks, stress points and faulty connectors. It also features a universal connector accepting any optical connector-style with 2.5-mm ferrule such as FC, SC, ST, E2000 and APC. LED indicates function status, such as ON and OFF of laser, continuous laser mode, pulse laser mode and low battery. This device includes two 1.5-V AAA batteries, cushioned vinyl carrying case, lens cap and an instruction sheet.

Ripley | www.ripley-tools.com

HD Electric Co. Web Site

HD Electric Co.'s new Web site has a clean, fresh look and showcases all of the company's manufactured products. Some new features allow visitors to:

- Request a copy of HD's Short Form Product Catalog
- Search for sales reps
- Search for products by name and description
- Download all product literature, manuals and articles
- View Latest News (upgraded with photos and the ability to view past news items)
- View product videos.

HD Electric Co.
www.HDElectricCompany.com



Breaker Analyzer

Shermco Industries has recently acquired the DILO 3-036-R050 breaker analyzer to compliment the company's existing testing abilities. The new equipment will help Shermco test for moisture, decomposition and purity of SF₆.

The DILO 3-036-R050 breaker analyzer is a modular device that uses up to three test cards to evaluate specific contaminants. The base unit contains a data logger and all necessary hardware to make a physical connection to gas-insulated equipment.

The compact, lightweight breaker analyzer tests all three contaminants: purity, moisture and decomposition; automatically validates readings; delivers test results quickly (in less than 6 minutes); stores test values on internal flash memory for future download to a PC; and powers by ac or eight hours of battery life.

Shermco Industries | www.shermco.com

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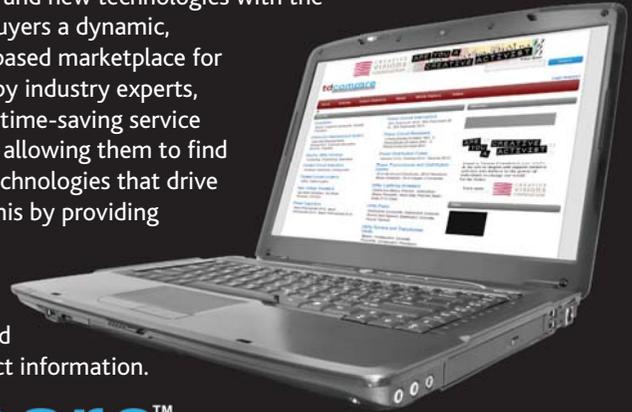
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Klein Tools and BlueVolt announce Klein Tools University, an online training resource for professional tradesmen in the electrical, construction, telecommunications and electronics fields.

Klein Tools University (www.kleintools.com) includes training on Klein Tools company history, products and product applications. Built on the BlueVolt mLMS learning management platform, courses come alive with a mix of video, interactive instruction and testing designed to engage the user and present information in a useful way.

The university, which is free for all users and available 24/7, is designed to expand with new courses to benefit the end-user. The mLMS platform provides powerful reports that allow Klein Tools to monitor training results in real-time and to ensure courses are effective and valuable.

Klein Tools | www.kleintools.com

Sonde Housing



Underground Tools Inc. unveils its new sonde housing. The 3/4-inch (19-mm)-thick access door on the sonde housing provides superior protection for valuable electronics. The housing is as much as 33% thicker than comparable units and features a slightly larger body diameter for greater wear resistance and durability.

The housing incorporates a seven-hole Vermeer pattern that is compatible with UTI pilot bits, including UTI Gold Series bits or Vermeer pilot bits. Custom adapters allow the housing to be used with all makes and models of drill rigs.

Underground Tools Inc.
www.undergroundtools.com

Power Trading

Open Access Technology International Inc. announces the patent application for the technology underlying OATI webAgent's Inter-RTO power-trading capabilities. The webAgent suite of products enables OATI customers to instantly identify trading opportunities between the North American ISOs and RTOs.

Using the patent-pending technology, the OATI webAgent solution completely automates the inter-market transactions to capture these opportunities in real-time. OATI webAgent is integrated with webTrader, OATI's front-to-back Energy Trading and Risk Management system.

OATI | www.oati.com

Silicone Coatings for Outdoor Insulators

The durability of POWERSIL silicone coatings for outdoor insulators is not affected even by many years of continuous use. That is the result of WACKER's outdoor endurance tests and current lab studies. They show that even after years of outdoor exposure to the elements, POWERSIL coatings retain their water-repellency and hence their beneficial electrical properties.

The POWERSIL portfolio of insulation materials for the T&D sector includes silicone coatings for porcelain and glass insulators. When conventional insulators are coated with POWERSIL, beneficial electrical properties are conferred on them thanks to the coating's water-repellent action (hydrophobicity). To assess the long-term stability of such coatings, WACKER performs accelerated weathering tests as per ISO 4892. For over 3000 hours, the coated test samples are irradiated with UV light and exposed to moisture. The state of the insulator coating is then determined by evaluating its water-repellent properties. The tests provide conclusive findings on the material's durability — data that could otherwise only be obtained from field tests spanning several years.

Wacker Chemie AG | www.wacker.com



Past

Present

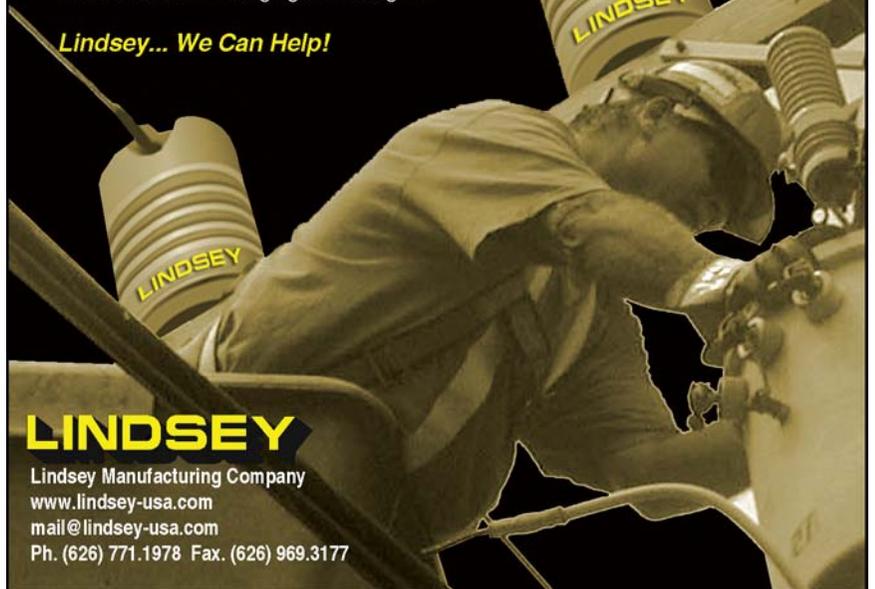
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Indoor Medium-Voltage Instrument Transformers

GE Digital Energy's new family of ITI Indoor Medium-Voltage (MV) Instrument Transformers includes voltage and current instrument transformers in the 7.2-, 12-, 17.5-, 24- and 36-kV classes. These new instrument transformers are ideal for operating meters, instruments, relays and control devices.

With the introduction of GE Digital Energy's ITI Indoor IEC MV family, utilities and OEMs in Latin America, Europe, the Middle East, Africa and Asia can now get their transformers from one source and be assured that the transformers have been designed, manufactured and tested in accordance with IEC standards. The new ITI Indoor IEC MV Instrument Transformers, available in custom designs, are compact in size and designed to use a minimal amount of space in MV switchgear.

The indoor MV transformers are manufactured and tested using state-of-the-art technology, helping to ensure high availability, reliability, consistency and shorter manufacturing lead times. The transformers are constructed of epoxy and polyurethane resins. Epoxy-resin transformers are manufactured using automated pressure gelation technology. Computer-controlled resin mixing and casting processes result in shorter manufacturing lead times and proven product consistency.
GE Digital Energy | www.gedigitalenergy.com

Graphic-Visualization Development Tools

GE Fanuc Intelligent Platforms, a unit of GE Enterprise Solutions, announces the latest release of DataViews 9.25, a set of high-quality graphic-visualization development tools for building custom applications. The new version includes new features that enhance performance of display updates, support the use of scalable text in input object templates and allow the setting of background color for scalable text objects.

DataViews 9.25 also introduces 64-bit operating system support for Red Hat Enterprise Version 5.3. This key feature enables developers to gain further performance from their application by having their DataViews-built components harness the 64-bit instruction set directly without the need of emulation. This is a key element for applications displaying a large amount of data in real time and ones requiring high performance.
GE Fanuc Intelligent Platforms | www.gefanuc.com/dataviews

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Hybrid Vehicle Battery Test System

SAKOR Technologies Inc.'s Hybrid Vehicle Battery Test System can effectively perform all types of performance and durability cycling.

At the heart of the system lies a high-efficiency line-regenerative DC power source. During discharge modes, absorbed power is regenerated back to the AC mains instead of being dissipated as wasted heat.

Driven by a DynoLAB EM controller, the system inherits DynoLAB's ability to automate all types of performance, durability and continuous cycling operations, including full road load simulation. In fact, the system can function both as a battery tester and as a battery simulator. Integration with a HybriDyne Hybrid Driveline Dynamometer creates a system capable of testing complete hybrid drivelines and subsystems with or without actual batteries in circuit. The system may be configured to provide dynamic response just as would be seen in-vehicle. The simulator output remains repeatable from cycle to cycle, regardless of charge status, resulting in more consistent and accurate test data.

SAKOR Technologies Inc.
www.sakor.com

Cycloaliphatic Epoxy-Based Resins

A key factor in Smart Grid power distribution systems is the ability to automatically and continuously reroute power to minimize outages. Long-time provider of equipment designed to deliver electric power efficiently and reliably, S&C Electric Co. is helping its customers provide high electric service reliability and power quality on overhead power lines via a PulseClosing technology that offers a new alternative to conventional automatic circuit reclosers.

S&C's new IntelliRupter PulseCloser detects short-circuit events, such as a lightning strike or tree limb hitting the line, and interrupts high-magnitude fault currents. Then, the device applies very fast low-energy pulses to the power line to determine if the line is still faulted or if it is clear and service can be restored. The pulses allow less than 2% of the energy let-through compared to a typical conventional recloser, so repeated system-damaging stresses and voltage sags are avoided. The device minimizes the need for repair crews to respond to all fault situations and reduces the incidence of blown fuses that require replacement by utility crews. The IntelliRupter PulseCloser features base-integrated controls provided by a secure WiFi link that can be configured and operated from a crew truck up to 150 ft (46 m) from the device or via a remote connection to the utility's SCADA system.

Contributing to the long-term reliability of each IntelliRupter is the Cypoxy cycloaliphatic epoxy used to mold several of the device's components. S&C formulates its Cypoxy using a base resin and accelerator supplied by Huntsman Advanced Materials. Huntsman's Araldite CY 184 easy-to-process epoxy is a resilient thermosetting polymer with solid arc and track resistance, excellent mechanical and electrical properties and high heat resistance.

The Cypoxy produced with the Huntsman materials is molded by S&C via automated pressure gelation (APG) to produce vacuum interrupter units that house voltage and current sensors, as well as integral power modules that derive energy directly from the distribution line without requiring pole-top transformers. APG-molded Cypoxy brand product is also used for insulators. The cycloaliphatic epoxy is lighter and more chip-resistant than porcelain, resists damage from ultraviolet light and maintains its performance characteristics when exposed to temperature and weather extremes.

S&C Electric Co. | www.sandc.com TDW

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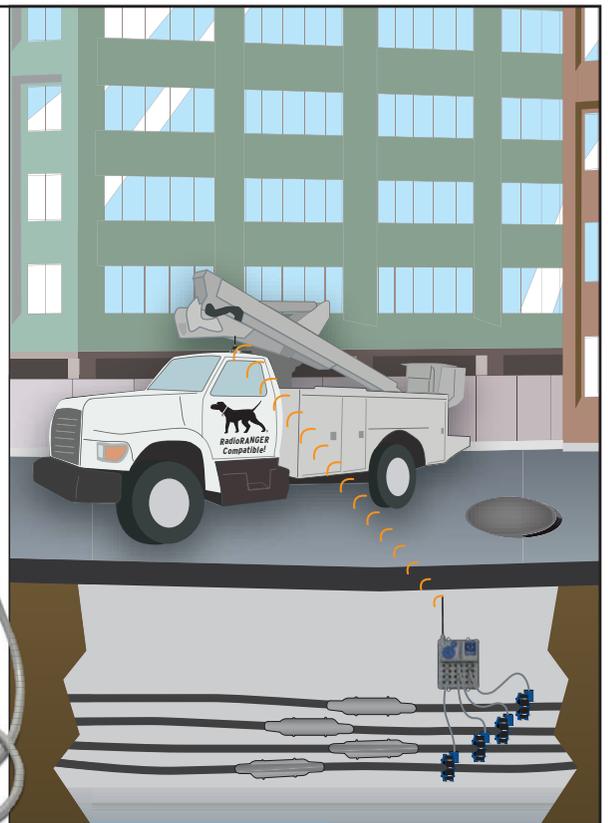
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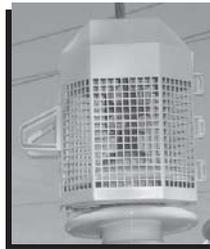
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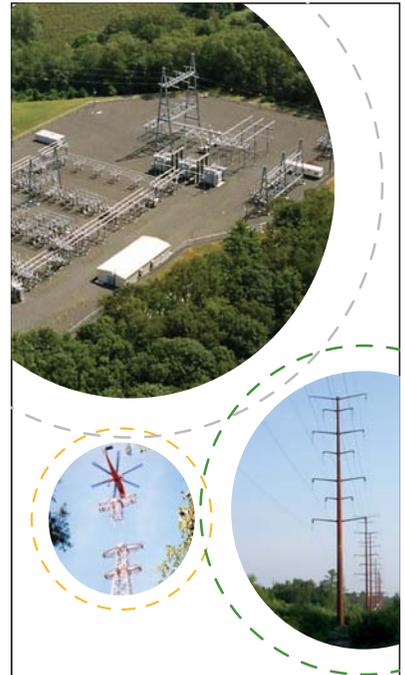
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Updating Infrastructure

By **David E. Schleicher**, PPL Electric Utilities



T **TRANSMISSION LINES ARE LIKE INTERSTATE HIGHWAYS** — a tightly interconnected network that moves large amounts of electricity over long distances from where it's generated to where it's used. PPL Electric Utilities owns 5000 miles (8047 km) of transmission lines — operated at 69 kV, 138 kV, 230 kV and 500 kV — in Pennsylvania.

Updating the grid is a critical factor in improving the nation's energy security and increasing the amount of intermittent, renewable energy generation available on the market, both of which are important public-policy objectives of the federal government.

Throughout the U.S., utilities are making significant investments in infrastructure to ensure they are able to meet the needs of tomorrow — better energy security for the nation, more clean energy on the market, safer and reliable electricity for customers. PPL Electric Utilities is embarking on a broad program of improvements that represents an investment of US\$2.5 billion in T&D infrastructure.

On a national level, the required investment in infrastructure will cost hundreds of billions of dollars. And with significant investments, come significant risks.

Multi-state, multi-utility approvals. Federal land crossings. Environmental studies. Siting concerns. Resource and material procurement challenges. Organized opposition. These are just a few of the factors that have the potential to delay a transmission line project or push it over budget.

The risks of doing nothing are far greater. Much of our transmission infrastructure was built in the 1960s and 1970s. In the area served by PPL Electric Utilities, electricity use has grown by nearly 500% since 1960. And despite the recent drop in electricity use as a result of the recession, the federal government estimates a continued increase in the use of electricity over the long term.

Our aging infrastructure will not allow us to meet this growing demand for electricity, maintain the high level of reliability our customers have come to expect, and accommodate new technologies that could make the grid more efficient and enable us to provide new services and options to customers.

The cornerstone of PPL Electric Utilities' expansion effort is the Susquehanna-Roseland project, a proposed 500-kV transmission line that will strengthen the regional grid across northeastern Pennsylvania and northern New Jersey. PJM Interconnection has directed PPL Electric Utilities to construct the Pennsylvania portion of this power line, while Public Service Electric and Gas is building the New Jersey portion.

Spanning more than 100 miles (161 km) in Pennsylvania and costing an estimated \$510 million, Susquehanna-Roseland is the largest T&D improvement project PPL Electric Utilities has embarked on in decades. The size and scope of this project, as well as the financial and credit pressures to accurately forecast cash flow and regulatory cost recovery, make risk management a critical factor in its success.

Because PJM has identified the need to have this line in place and operating by May 2012 to prevent overloads on existing transmission lines, there isn't much margin for error. Siting, permitting, design, procurement and construction must coordinate seamlessly for the project to be successful.

The project team started with a risk assessment. Conducting this assessment was critical to identify all the potential obstacles and put contingency plans in place to address them. The risk assessment also helped us gauge how likely it would be to meet the deadline and budget we set for the project.

The most valuable part of the risk assessment was getting all the subject matter experts — siting crews, environmentalists, engineers, accountants, lawyers and communicators — in one room. With everyone at the table we had a good sense of all the "what ifs" before we even began working on the project.

About 35 people on the project team worked together to come up with a list of risks and uncertainties that could delay the project or add to the costs. No stone was left unturned, as the team narrowed the list to 12 risks that were substantial enough to merit further evaluation.

Having the details on each potential hurdle has given us the tools we need to focus on mitigation strategies. Now we can take a proactive approach, handling obstacles before they become insurmountable. As certain risks were mitigated, we developed a critical path for the project and increased the likelihood of achieving our desired schedule. With ongoing monthly assessments, risk management has become an integral part of the work done on the Susquehanna-Roseland project. It's a practice that has become a standard part of the process at PPL Electric Utilities as we embark on a growing number of large-scale projects to upgrade our T&D facilities.

Having a detailed, forward-looking view of a project's potential risks will ensure the success of our infrastructure improvement efforts so that we can continue to provide customers with safe and reliable electric service. **TDW**

David E. Schleicher (deschleicher@pplweb.com) is vice president of transmission for PPL Electric Utilities.



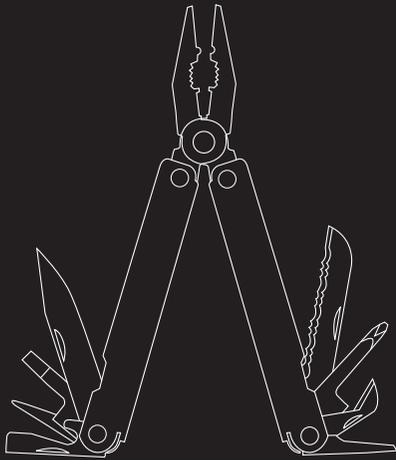
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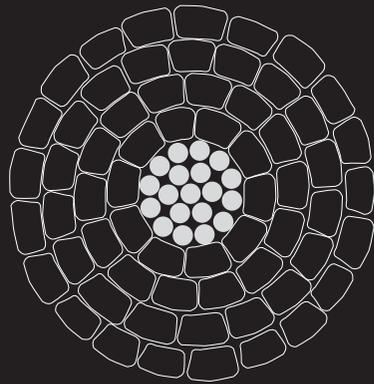
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Customers Benefit from Single-Phase Reclosing

Can we prevent customers served on phase A from being affected by a fault on phase C?

By **Julio Romero Agüero**, *Quanta Technology*, and **Laura Whittington**, *Commonwealth Edison*

POTENTIAL RELIABILITY BENEFITS COULD BE ACHIEVED THROUGH THE IMPLEMENTATION of single-phase reclosing and lockout in distribution feeders. However, several issues and misconceptions regarding potential problems must be addressed first.

Despite the potential problems, the improvement to system average interruption duration index (SAIDI) is real and demands attention.

FAULT PROTECTION

Historically, the fault protection of distribution feeders has been accomplished with protective devices such as fuses and reclosers, which are applied using one of two overcurrent-protection philosophies:

- *Fuse blowing.* Reclosers and fuses are coordinated so that both temporary and permanent faults are isolated by blowing the fuse immediately upstream of the fault. This is also known as fuse clearing.

- *Fuse saving.* Reclosers and fuses are coordinated to allow temporary faults to self-extinguish during the reclosing intervals. Only permanent faults are isolated by blowing the upstream fuse.

Typically, three-phase reclosers are installed in main trunks and sometimes in long or highly loaded three-phase laterals. Single-phase reclosers are installed in single-phase and two-phase laterals and sometimes in three-phase laterals. Modern three-phase reclosers, such as the one in Fig. 1, are designed to allow the reclosing and lockout of individual phases. Similarly, modern single-phase reclosers can be controlled to reclose and lockout all phases simultaneously.

RECLOSING SCHEMES

Reclosers are fundamental to improving the reliability of distribution systems. However, independently of the fault's nature (temporary or sustained and single phase, two phase or three phase), the reclosing attempts and lockout operation of a conventional three-phase recloser affect all three phases of the distribution system, causing momentary or sustained interruptions to all downstream customers.

This sort of three-phase reclosing and lockout is not optimal from the point of view of customer reliability indices. Why do customers served by phase A of a feeder have to be affected by a fault that occurs in phase C of the feeder? This criticism and the availability of modern reclosers have driven the implementation of other reclosing schemes for



Fig. 1. A typical three-phase recloser installed on a main feeder can operate all three phases simultaneously, or allow operation and lockout of individual phases.

improving the reliability of the distribution system.

Modern reclosers are capable of providing the classic and most-common protection scheme used by utilities. In this scheme, all phases trip and reclose during the reclosing cycle, and all phases lock out if the fault is permanent.

A second functionality is available providing single-phase reclosing and three-phase lockout. In this mode, only the faulted phase trips and recloses. Lockout, if required, affects all phases. This scheme is similar to that used for transmission lines, and it is starting to become more popular for distribution applications.

A third scheme involves both single-phase reclosing and single-phase lockout. This is the most controversial and least-common application of modern reclosers. Nevertheless, some utilities are starting to implement this scheme, which can lead to significant reliability benefits.

ISSUES AND CONCERNS

The implementation of single-phase reclosing is controversial for several reasons. One is the possible impact of this sort of system operation on the equipment, especially the impact of losing one phase for those customers using three-phase motors. While this can be a valid concern, it is worth noting that the protection against the loss of one phase is part of a typical protection scheme for three-phase motors. And, of course, customers are also responsible to develop protection schemes to protect their equipment.

It is also worth noting that, for decades, utilities all over the world have been installing fuses (one per phase) in three-phase laterals. In this situation, a single-phase fault causes the operation of only one fuse, producing exactly the same effect as the single-phase lockout of a recloser would produce. Similarly, it also has been a relatively common practice to install three single-phase reclosers in long three-phase lines, usually in rural areas. Many of these single-phase reclosers do not have the capability of locking out the three phases simultaneously, which leads to single-phase lockout when a permanent single-phase fault occurs downstream.

Another concern is related to the unbalanced protection of the feeder, specifically with the operation of the ground overcurrent relay. When only

one phase of a recloser locks out, it creates an unbalance that can cause the operation of the ground overcurrent relay. This can be overcome in many situations by modifying the relay settings to increase the tolerance for higher unbalance or by limiting the application of single-phase reclosing to sections of the feeder where the unbalance is not significant enough to cause the operation of the ground overcurrent relay.

Additionally, a potential issue to consider, according to the regulations of some states in the United States, is that the loss of service in at least one phase of a three-phase customer is considered a sustained interruption for reliability purposes.

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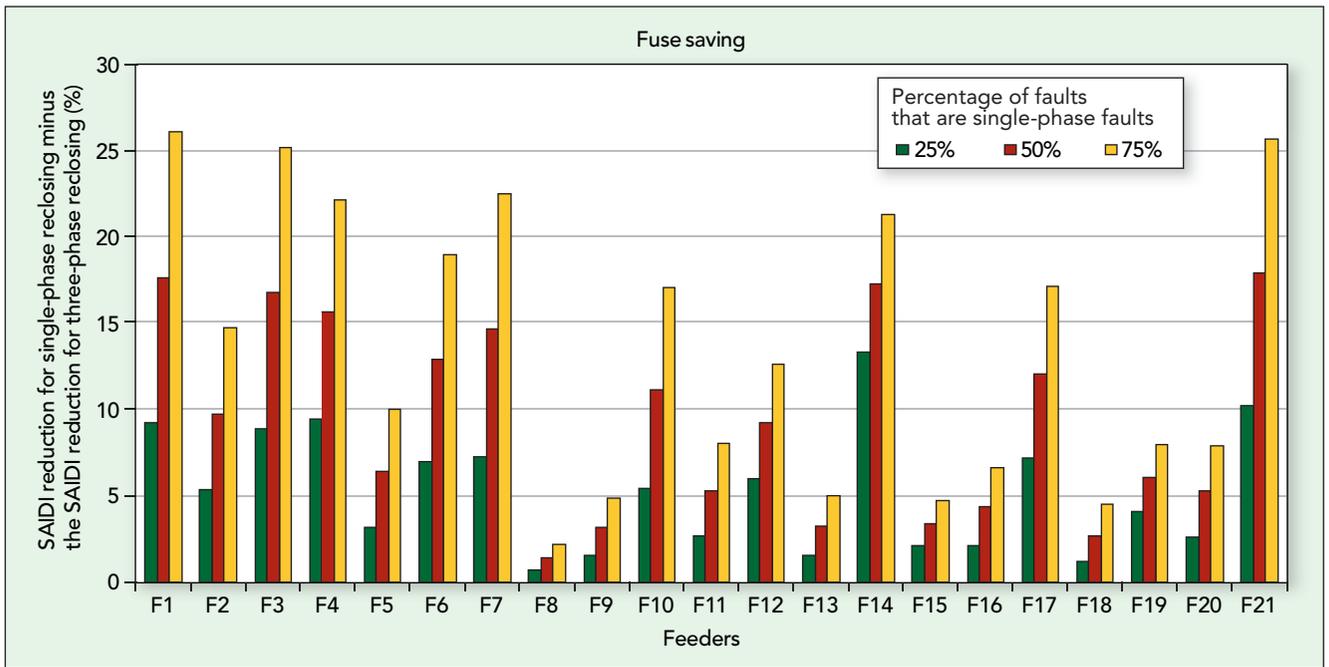


Fig. 2. Fuse saving is used: Difference in SAIDI reduction achieved through single-phase reclosing (1P) and three-phase reclosing (3P).

While this is also a valid argument, it is worth noting that if the loss of service was due to a fault, the three-phase customer would be affected by an interruption independent of the reclosing scheme being used. Furthermore, if three-phase reclosing were used, not only the three-phase customers would be affected, but so would all the other customers located downstream of the recloser. However, if single-phase reclosing were used, only those customers served by the faulted phase (including the three-phase customers) would be interrupted and counted for reliability purposes.

Other concerns are related to backfeed, ferroresonance and the potential interaction of reclosers and distributed generation. These issues are analyzed on a case-by-case basis.

RELIABILITY BENEFITS

In order to show the advantages and reliability benefits of single-phase reclosing, a comprehensive study was performed for a typical distribution system. This study analyzed the impact of the installation of reclosers for improving the reliability (SAIDI) of the distribution system. The system consists of 36 feeders (12.5 kV), with a total of 36,476 customers, and has the typical four-wire multi-grounded layout used in the United States, with single-phase and three-phase distribution transformers. The study estimated and compared the reliability benefits due to the installation of 24 reclosers in 21 feeders for both protection philosophies — fuse saving and fuse blowing — and two reclosing schemes — single phase and three phase.

The reliability benefits were estimated using a predictive reliability model (PRM) developed using the SynerGEE Electric solution from GL (Hamburg, Germany). The PRM was built from a typical power flow model. The power flow model included all the data about the connectivity of the system, distribution system components and distribution transformer

loads. The PRM was built by allocating customers to all distribution transformers and assigning reliability parameters, such as failure rates and mean times to repair (MTTR), to all distribution system components (overhead and underground lines, protective and switching devices, and distribution equipment).

The reliability parameters of the distribution equipment and protective and switching devices were assigned using data available from several sources such as manufacturers, specialized literature and industry data. The reliability parameters of overhead and underground lines were calibrated using historical reliability and outage data for the last five years. These parameters were calibrated in such a way that the reliability indices, SAIDI and system average interruption frequency index (SAIFI), calculated by the PRM match the average value of the historical reliability indices from the last five years.

The historical reliability indices were calculated per the IEEE 2.5 Beta Method for major event exclusion. Within the model limitations, the calibrated PRM represents the current reliability of the distribution system. The calibrated PRM is the “base model” for reliability analysis, and the calibrated reliability indices are the “base reliability” of the system.

The PRM simulates faults in all components according to their respective failure rates and MTTR, and then it calculates the corresponding reliability indices (SAIDI and SAIFI). Therefore, the benefits of installing a set of reclosers can be estimated by comparing the reliability indices calculated by the PRM before and after installing the reclosers. During the simulations and analyses performed in this study, all the reclosers were operated using three-phase reclosing or single-phase reclosing. The reclosers were installed in strategic locations on the system in order to try to increase their reliability benefits and effectiveness. Reliability indices were calculated for all combinations of fuse saving and fuse blowing protec-



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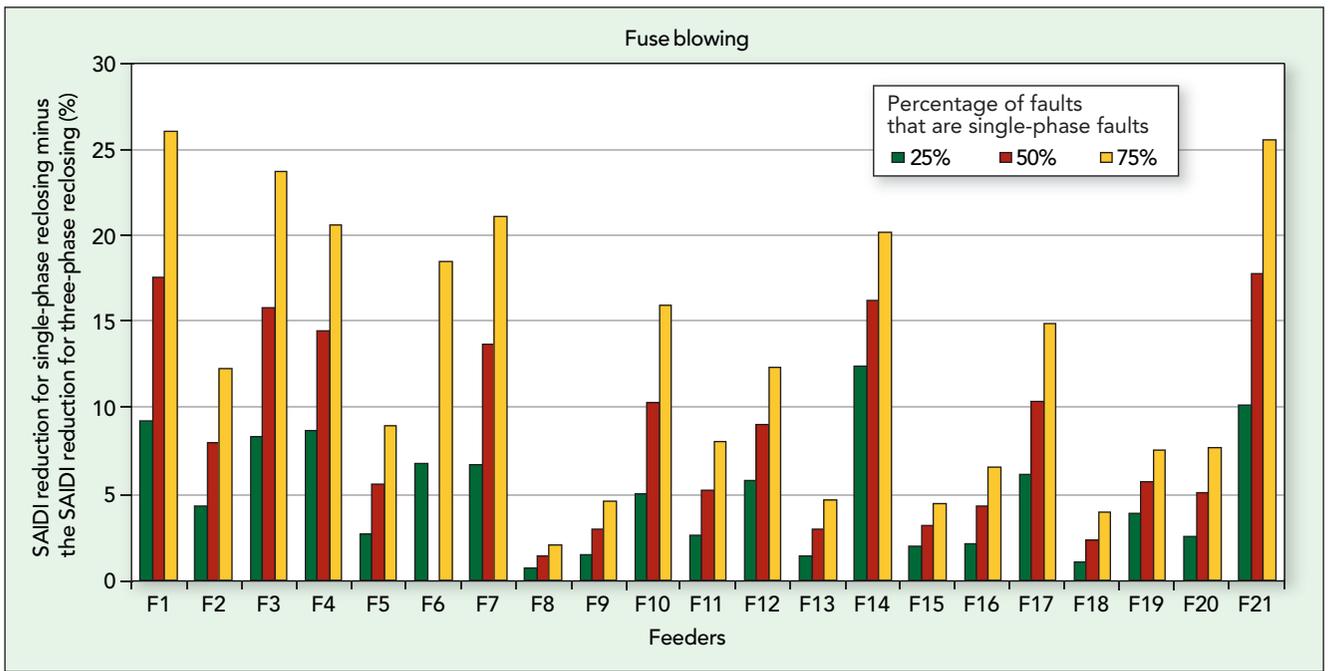


Fig. 3. Fuse blowing is used: Difference in SAIDI reduction achieved through single-phase reclosing (1P) and three-phase reclosing (3P).

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SINGLE-PHASE FAULT COMPONENT

One variable that influences the effectiveness of single-phase reclosing is the percentage of single-phase faults that occur in the distribution system. For each condition, results were calculated for three different percentages of single-phase faults: 25%, 50% and 75%. These percentages indicate the ratio of faults that are single phase with respect to the total number of faults in the system.

This variable will have a significant influence. For instance, if all faults that occur in the distribution system were three phase, then both single-phase reclosing and three-phase reclosing would have the same impact on reliability. Nevertheless, since most faults in the distribution system are typically single phase, it is expected that the reliability benefits of single-phase reclosing are significant.

SIMULATION RESULTS

The PRM simulation results show that single-phase reclosing achieves a higher reduction in SAIDI than three-phase reclosing, and that this reduction increases as the percentage of single-phase faults increases from 25% to 75%. This is true for both fuse-saving and fuse-blowing protection philosophies.

These results are explicitly shown in Fig. 2, which presents a plot of the differences between the SAIDI reduction attained by single-phase reclosing and three-phase reclosing. The plots show that for both overcurrent protection philosophies, single-phase reclosing achieves larger improvements in SAIDI than three-phase reclosing.

This shows that the difference in SAIDI reduction attained by both reclosing schemes can be notable for some feeders. For instance, if 75% of faults in feeder F1 were single phase

and fuse saving were used, the SAIDI reduction attained by single-phase reclosing would be 33% with respect to the base case. On the other side, the SAIDI reduction achieved by three-phase reclosing would only be 6%, which would lead to a significant difference of about 27% between both reclosing schemes. This is the value shown in Fig. 3.

These results demonstrate the notable potential reliability benefits that can be attained by implementing a single-phase reclosing scheme. These noteworthy benefits justify considering and further analyzing the possibility of implementing single-phase reclosing as part of a standard approach for improving the reliability of distribution feeders. For instance, this application is particularly attractive for feeders with mostly residential customers, where problems related with three-phase motor loads are not a concern. TDW

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Laura Whittington (laura.whittington@ComEd.com) is a staff planner in the distribution capacity planning department at ComEd (Oakbrook Terrace, Illinois, U.S.) and has been with the company since 1988. Her experience ranges from metering applications to long-range planning. She holds a BSEE degree from Marquette University and is a member of the IEEE Power & Energy Society.



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Rendered for Ventyx by Bolder Geographics, the 2009 U.S. Renewable Energy Wall Map measures 48 inches by 92 inches (1219 mm by 2337 mm) and shows existing and planned renewable facilities, transmission lines (existing and proposed), conventional plants, wind resource measurements, solar and geothermal resources, states, counties, cities and topography. **Ventyx | www.globalenergymaps.com**

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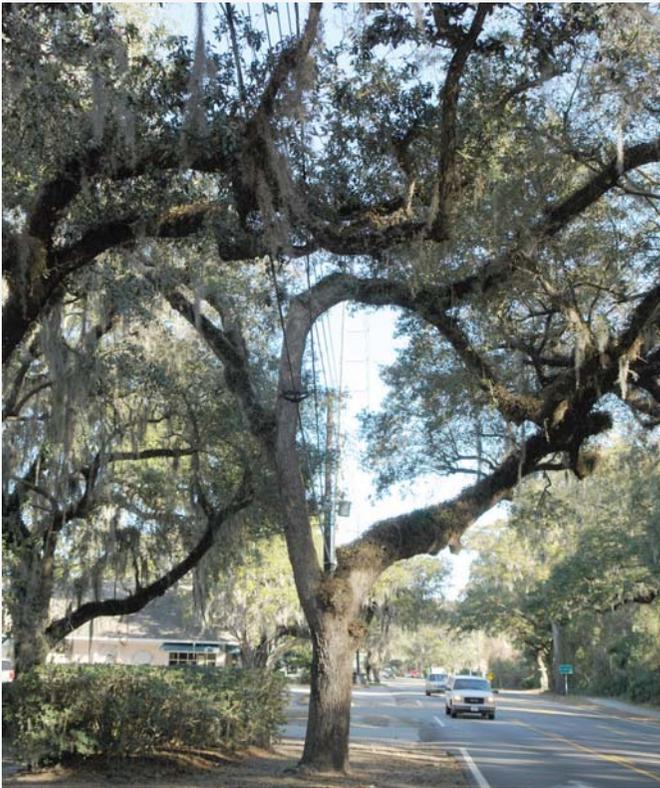
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A view from the switch structure down the right-of-way. The oaks are beautiful but can cause interruptions on the island to both residents and tourists alike.



Travis Watts prepares for hot line work on site. He is the crew leader at the local Brunswick Transmission Maintenance Center and performed the LineTracker installation on the conductors.

eliminating the need for a solar or battery source. In this installation, the DataPAC is attached to the switch pole, using stainless straps, just above the RTU cabinet for local power access. GridSense also has initiated discussions with a major switch manufacturer to integrate this receiver system into the manufacturer's motor operator enclosure to optimize and streamline both the installation and application.

In addition to communicating with GridSense's LineMan Remote and GServer software, the newly redesigned DataPAC includes DNP3 protocol for supervisory control and data acquisition (SCADA) integration. The DataPAC can be configured in a fully polled mode, a report-by-exception (unsolicited) mode or a combination of the two modes. This allows the information to be broadcasted back to generate real-time data on a screen and to record alarms such as a fault indication, which is the primary function in the pilot project.

Given this alarm, the control center has the knowledge needed to make the decision on which switch to open in order to restore service to the most customers within the shortest amount of time. This not only decreases system average interruption duration index (SAIDI) numbers as a whole, but it assists in eliminating damage to breakers, switches, transformers and other hardware by preventing the accidental closure of a switch or breaker into an unisolated line fault.

In addition to the wireless data communication, the LineTracker devices also have red and amber LEDs on the bottom that provide a good visual indication for field personnel, as any standard fault indicator would. The amber LED advises when voltage and current are present through three flash sequences, and the red LED advises self-clearing short and long interruptions through three flash sequences.

FUTURE APPLICATIONS

Georgia Power is using this technology on St. Simon's Island in a pilot case, in preparation for a broader rollout. In addition to simply being a smart fault indicator, the LineTracker has the ability transmit other real-time data that may



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The complete installation with the inconspicuous LineTrackers hanging on the conductors to the left of the switch.

revolutionize the power grid. Additional uses include transmission monitoring, line capacity ratings, troubleshooting, capacity planning and asset optimization. Currently, the LineTracker devices are configured to monitor and transmit:

- Event types (momentary, sustained, power restoration and fault current detected)
- Voltage presence
- Current (real-time current in addition to pre- and post-fault current)
- Temperature (ambient and conductor surface temperature)
- DataPAC and LineTracker battery voltage.

Twelve-cycle fault waveforms (current and relative voltage) and load profiles (current, power factor and phase angle) are also available through the DNP3 protocol. It is highly recommended the LineTracker devices be installed on the load (normally energized) side of the switch, so they not only indicate fault currently flowing through the switch, but also verify that voltage is present on the load side of the switch. This confirms the line leading to the switch is in service, even with the switch in the open position because of a downstream fault.

SMART SWITCHING AND RATINGS

Georgia Power also has been experimenting with the expansion of this technology in the area of real-time line capacity rating, or dynamic line capacity rating, which is the real-time rating of a conductor due to environmental conditions (i.e., wind, ambient temperature, rain, sun, etc.). This would



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In this complete installation, the DataPAC is attached just above the RTU enclosure with two ½-inch stainless-steel straps.

allow a conductor to possibly have an increased capacity at different times or under different climatic conditions. LineTracker devices have the potential to move the industry a step further in the direction of this theory by reporting the real-time current and temperature to the control desk.

Additional plans include the possible expansion of integrating a third-party system to create an automated line scheme on the radial line. This automated system would control the switches automatically to restore power by isolating the section of line with the fault on it between breaker operations, thus allowing the breaker to return to normal after a reclose. Other options would include the line to continue to lock out and then for the system to take over, isolate the fault and automatically close the breaker to restore power to the line.

Much of the automation has been pioneered in the distribution arena, and transmission has been limited because of the inherent characteristics of the system, such as the distances between switches and breakers on the line and the limitations of an automated system. Several different systems have been researched to perform this automation, and the application of the Linetracker devices in this system is still in analysis.

SMART INVESTMENT

One of the primary benefits of the GridSense system is the financial savings over other conventional potential and current transformers at transmission voltages, allowing for

more units on the system for the same price as conventional methods. This investment in the grid will then allow for more cost savings in the future by increasing reliability to sensitive customers, reducing the number of customers involved in a long-term outage, and by providing accurate information needed to isolate a fault to prevent additional exposure to valuable equipment on the system. **TDW**

Jason T. Payne (jtpayne@southernco.com) is a transmission engineer for Georgia Power Co. Since coming onboard with Georgia Power, Payne has worked in design, protection and controls, and is currently in the maintenance and reliability organization. Since being involved with this organization, he has pushed the envelope of technology within the transmission system, looking for new or old ideas and products to save expenses and reduce outages on the grid. Payne holds BSEE and BSCE degrees from the University of South Carolina, has 15 years of utility experience and is a registered professional engineer.



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Customers Benefit from Single-Phase Reclosing

Can we prevent customers served on phase A from being affected by a fault on phase C?

By **Julio Romero Agüero**, *Quanta Technology*, and **Laura Whittington**, *Commonwealth Edison*

POTENTIAL RELIABILITY BENEFITS COULD BE ACHIEVED THROUGH THE IMPLEMENTATION of single-phase reclosing and lockout in distribution feeders. However, several issues and misconceptions regarding potential problems must be addressed first.

Despite the potential problems, the improvement to system average interruption duration index (SAIDI) is real and demands attention.

FAULT PROTECTION

Historically, the fault protection of distribution feeders has been accomplished with protective devices such as fuses and reclosers, which are applied using one of two overcurrent-protection philosophies:

- *Fuse blowing.* Reclosers and fuses are coordinated so that both temporary and permanent faults are isolated by blowing the fuse immediately upstream of the fault. This is also known as fuse clearing.

- *Fuse saving.* Reclosers and fuses are coordinated to allow temporary faults to self-extinguish during the reclosing intervals. Only permanent faults are isolated by blowing the upstream fuse.

Typically, three-phase reclosers are installed in main trunks and sometimes in long or highly loaded three-phase laterals. Single-phase reclosers are installed in single-phase and two-phase laterals and sometimes in three-phase laterals. Modern three-phase reclosers, such as the one in Fig. 1, are designed to allow the reclosing and lockout of individual phases. Similarly, modern single-phase reclosers can be controlled to reclose and lockout all phases simultaneously.

RECLOSING SCHEMES

Reclosers are fundamental to improving the reliability of distribution systems. However, independently of the fault's nature (temporary or sustained and single phase, two phase or three phase), the reclosing attempts and lockout operation of a conventional three-phase recloser affect all three phases of the distribution system, causing momentary or sustained interruptions to all downstream customers.

This sort of three-phase reclosing and lockout is not optimal from the point of view of customer reliability indices. Why do customers served by phase A of a feeder have to be affected by a fault that occurs in phase C of the feeder? This criticism and the availability of modern reclosers have driven the implementation of other reclosing schemes for



Fig. 1. A typical three-phase recloser installed on a main feeder can operate all three phases simultaneously, or allow operation and lockout of individual phases.

improving the reliability of the distribution system.

Modern reclosers are capable of providing the classic and most-common protection scheme used by utilities. In this scheme, all phases trip and reclose during the reclosing cycle, and all phases lock out if the fault is permanent.

A second functionality is available providing single-phase reclosing and three-phase lockout. In this mode, only the faulted phase trips and recloses. Lockout, if required, affects all phases. This scheme is similar to that used for transmission lines, and it is starting to become more popular for distribution applications.

A third scheme involves both single-phase reclosing and single-phase lockout. This is the most controversial and least-common application of modern reclosers. Nevertheless, some utilities are starting to implement this scheme, which can lead to significant reliability benefits.

ISSUES AND CONCERNS

The implementation of single-phase reclosing is controversial for several reasons. One is the possible impact of this sort of system operation on the equipment, especially the impact of losing one phase for those customers using three-phase motors. While this can be a valid concern, it is worth noting that the protection against the loss of one phase is part of a typical protection scheme for three-phase motors. And, of course, customers are also responsible to develop protection schemes to protect their equipment.

It is also worth noting that, for decades, utilities all over the world have been installing fuses (one per phase) in three-phase laterals. In this situation, a single-phase fault causes the operation of only one fuse, producing exactly the same effect as the single-phase lockout of a recloser would produce. Similarly, it also has been a relatively common practice to install three single-phase reclosers in long three-phase lines, usually in rural areas. Many of these single-phase reclosers do not have the capability of locking out the three phases simultaneously, which leads to single-phase lockout when a permanent single-phase fault occurs downstream.

Another concern is related to the unbalanced protection of the feeder, specifically with the operation of the ground overcurrent relay. When only

one phase of a recloser locks out, it creates an unbalance that can cause the operation of the ground overcurrent relay. This can be overcome in many situations by modifying the relay settings to increase the tolerance for higher unbalance or by limiting the application of single-phase reclosing to sections of the feeder where the unbalance is not significant enough to cause the operation of the ground overcurrent relay.

Additionally, a potential issue to consider, according to the regulations of some states in the United States, is that the loss of service in at least one phase of a three-phase customer is considered a sustained interruption for reliability purposes.

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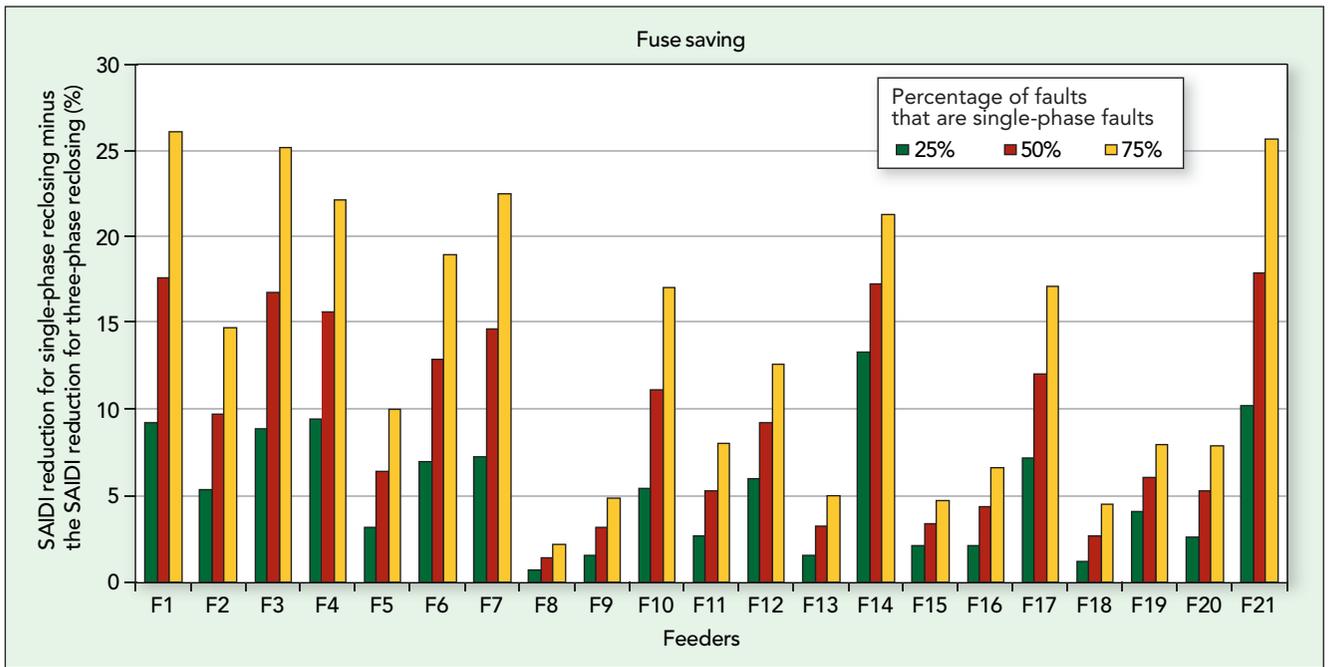


Fig. 2. Fuse saving is used: Difference in SAIDI reduction achieved through single-phase reclosing (1P) and three-phase reclosing (3P).

While this is also a valid argument, it is worth noting that if the loss of service was due to a fault, the three-phase customer would be affected by an interruption independent of the reclosing scheme being used. Furthermore, if three-phase reclosing were used, not only the three-phase customers would be affected, but so would all the other customers located downstream of the recloser. However, if single-phase reclosing were used, only those customers served by the faulted phase (including the three-phase customers) would be interrupted and counted for reliability purposes.

Other concerns are related to backfeed, ferroresonance and the potential interaction of reclosers and distributed generation. These issues are analyzed on a case-by-case basis.

RELIABILITY BENEFITS

In order to show the advantages and reliability benefits of single-phase reclosing, a comprehensive study was performed for a typical distribution system. This study analyzed the impact of the installation of reclosers for improving the reliability (SAIDI) of the distribution system. The system consists of 36 feeders (12.5 kV), with a total of 36,476 customers, and has the typical four-wire multi-grounded layout used in the United States, with single-phase and three-phase distribution transformers. The study estimated and compared the reliability benefits due to the installation of 24 reclosers in 21 feeders for both protection philosophies — fuse saving and fuse blowing — and two reclosing schemes — single phase and three phase.

The reliability benefits were estimated using a predictive reliability model (PRM) developed using the SynerGEE Electric solution from GL (Hamburg, Germany). The PRM was built from a typical power flow model. The power flow model included all the data about the connectivity of the system, distribution system components and distribution transformer

loads. The PRM was built by allocating customers to all distribution transformers and assigning reliability parameters, such as failure rates and mean times to repair (MTTR), to all distribution system components (overhead and underground lines, protective and switching devices, and distribution equipment).

The reliability parameters of the distribution equipment and protective and switching devices were assigned using data available from several sources such as manufacturers, specialized literature and industry data. The reliability parameters of overhead and underground lines were calibrated using historical reliability and outage data for the last five years. These parameters were calibrated in such a way that the reliability indices, SAIDI and system average interruption frequency index (SAIFI), calculated by the PRM match the average value of the historical reliability indices from the last five years.

The historical reliability indices were calculated per the IEEE 2.5 Beta Method for major event exclusion. Within the model limitations, the calibrated PRM represents the current reliability of the distribution system. The calibrated PRM is the “base model” for reliability analysis, and the calibrated reliability indices are the “base reliability” of the system.

The PRM simulates faults in all components according to their respective failure rates and MTTR, and then it calculates the corresponding reliability indices (SAIDI and SAIFI). Therefore, the benefits of installing a set of reclosers can be estimated by comparing the reliability indices calculated by the PRM before and after installing the reclosers. During the simulations and analyses performed in this study, all the reclosers were operated using three-phase reclosing or single-phase reclosing. The reclosers were installed in strategic locations on the system in order to try to increase their reliability benefits and effectiveness. Reliability indices were calculated for all combinations of fuse saving and fuse blowing protec-



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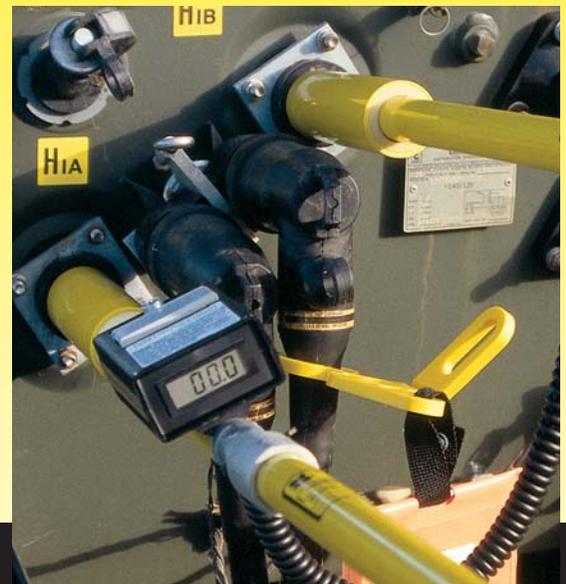
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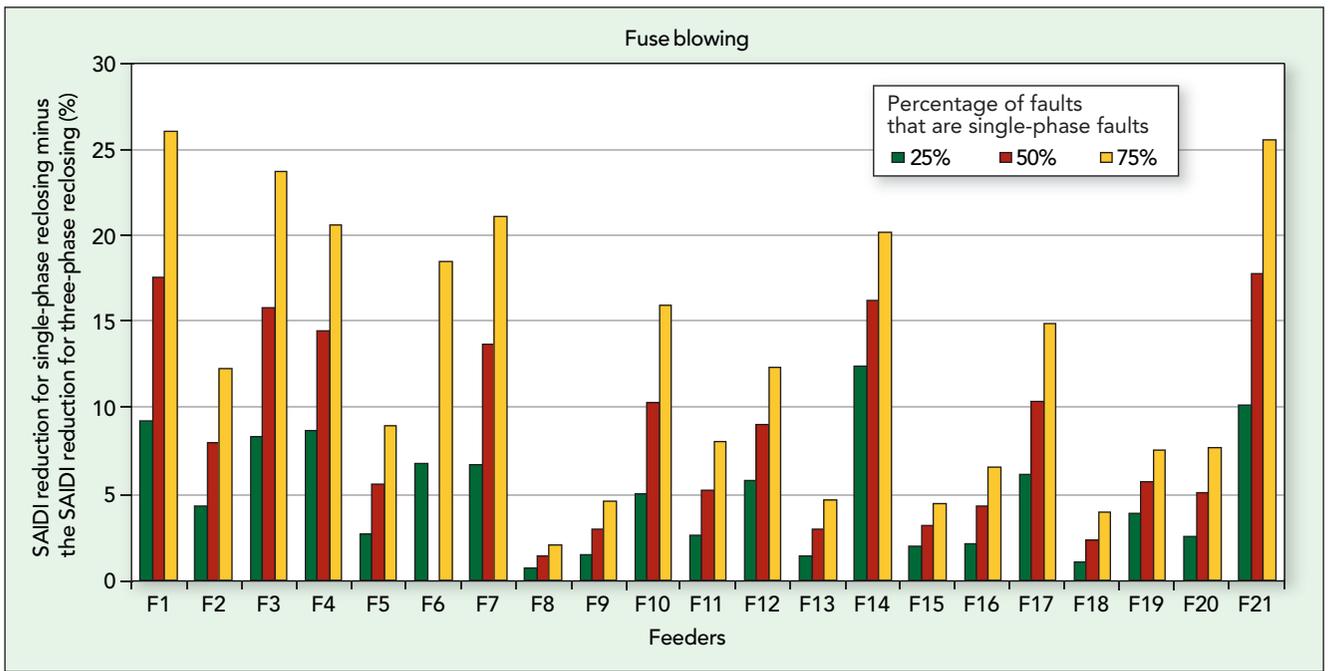


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Laura Whittington (laura.whittington@ComEd.com) is a staff planner in the distribution capacity planning department at ComEd (Oakbrook Terrace, Illinois, U.S.) and has been with the company since 1988. Her experience ranges from metering applications to long-range planning. She holds a BSEE degree from Marquette University and is a member of the IEEE Power & Energy Society.

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The 2009 U.S. Renewable Energy Wall Map is available from Ventyx. This fifth edition of the popular map has been updated to show the status of renewable energy in the U.S. electric generation mix as of Jan. 1, 2009, and is the most comprehensive view of this rapidly expanding sector of the U.S. energy industry.

Using data from the Ventyx Velocity Suite energy intelligence solution, the full-color map displays more than 1100 existing plants and almost 750 proposed power plants fueled by renewable sources such as wind, biomass, geothermal, solar and tidal power. The map clearly shows that wind power is still the lion's share of renewable projects, with an operating and planned increase of 38% and 74%, respectively, over the past 12 months. Conversely, installed biomass capacity has dropped 26% and planned by 64%. Solar and geothermal data reflect increases of about 5% each. Because all of these projects require a grid-connection, the map also identifies more than 40,000 miles (64,374 km) of proposed transmission lines and nearly 400 substation projects currently on the drawing board.

Rendered for Ventyx by Bolder Geographics, the 2009 U.S. Renewable Energy Wall Map measures 48 inches by 92 inches (1219 mm by 2337 mm) and shows existing and planned renewable facilities, transmission lines (existing and proposed), conventional plants, wind resource measurements, solar and geothermal resources, states, counties, cities and topography. **Ventyx | www.globalenergymaps.com**

Single-Phase UPS

Single-phase Uninterruptible Power Supplies (UPS) from Staco Energy Products Co. are ideal for demanding industrial applications like control and relay protection, keeping assembly lines operating, process systems backup and more.



Industry-leading functionality includes hot-swappable batteries, a powerful internal battery charger, emergency shutdown and programmable receptacles. This double-conversion UPS protects from outages and irregularities in incoming line voltages from 60 Vac to 144 Vac (120-Vac input) or 120 Vac to 288 Vac (230-Vac input) at 45 Hz to 65 Hz.

The Smart Battery Management System monitors battery status and recharges whenever necessary. Hot-swappable battery packs allow users to change batteries without shutting down the UPS, further simplifying maintenance.

Staco also offers UniStar III Series in a tower design for 1 kVA, 2 kVA and 3 kVA and UniStar P Series for larger installations rated at 6 kVA, 8 kVA and 10 kVA.

Every Staco single-phase UPS is easy to install and monitor. Easy-to-read front-panel LCD display includes input and output voltage, input and output frequency, load percentage, battery voltage and inner temperature. Alarms are provided for line mode, backup mode, ECO mode, bypass supply, battery low, battery bad/disconnect, overload, transferring with interruption and UPS fault, line failure, battery low, transfer to bypass and system fault conditions. Each size offers remote monitoring and diagnostic capabilities through an RS232 serial port and optional Web, USB, SNMP or dry contact cards. **Staco Energy Products Co. | www.stacoenergy.com**

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Fiber-Optic Visual Fault Locator



Ripley introduces the Fiber Optic Visual Fault Locator (FO-VFL). The slim pen-style 650-nm red visible laser diode fault locator for single and multimode fiber is designed for field personnel who need an efficient and economical tool for fiber tracing, fiber routing and continuity checking in an optical network, during and after installation.

The pen detects fiber breaks, fiber leaks, stress points and faulty connectors. It also features a universal connector accepting any optical connector-style with 2.5-mm ferrule such as FC, SC, ST, E2000 and APC. LED indicates function status, such as ON and OFF of laser, continuous laser mode, pulse laser mode and low battery. This device includes two 1.5-V AAA batteries, cushioned vinyl carrying case, lens cap and an instruction sheet.

Ripley | www.ripley-tools.com

HD Electric Co. Web Site

HD Electric Co.'s new Web site has a clean, fresh look and showcases all of the company's manufactured products. Some new features allow visitors to:

- Request a copy of HD's Short Form Product Catalog
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- View product videos.

HD Electric Co.
www.HDElectricCompany.com



Breaker Analyzer

Shermco Industries has recently acquired the DILO 3-036-R050 breaker analyzer to compliment the company's existing testing abilities. The new equipment will help Shermco test for moisture, decomposition and purity of SF₆.

The DILO 3-036-R050 breaker analyzer is a modular device that uses up to three test cards to evaluate specific contaminants. The base unit contains a data logger and all necessary hardware to make a physical connection to gas-insulated equipment.

The compact, lightweight breaker analyzer tests all three contaminants: purity, moisture and decomposition; automatically validates readings; delivers test results quickly (in less than 6 minutes); stores test values on internal flash memory for future download to a PC; and powers by ac or eight hours of battery life.

Shermco Industries | www.shermco.com



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DIN-Rail Adapter

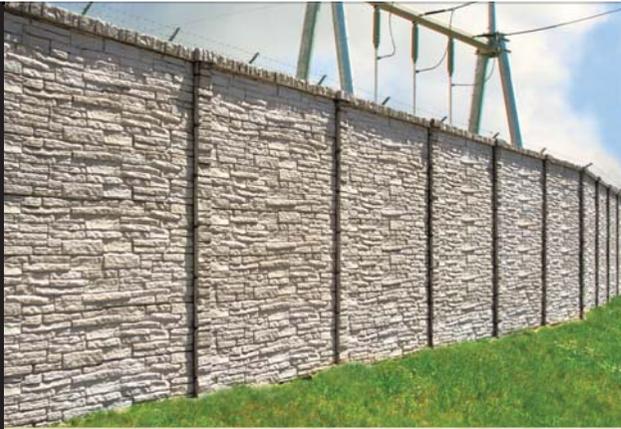
Telkonet Inc. announces a time- and labor-saving addition to its 200 Mbps Telkonet Series 5 powerline communications (PLC) system, with the introduction of the new DIN-Rail mounting adapter.

Designed for use with the Telkonet iBridge converter unit, the DIN-Rail adapter overcomes the problems of limited space in utility substation equipment cabinets, enabling the iBridge units to be mounted vertically for maximum efficiency. The DIN-Rail adapters substantially decrease installation times, simply snapping onto the standard DIN-rails used for equipment mounting.

The Telkonet Series 5 System uses existing electrical wiring within a substation to provide a reliable, secure communications network, enabling proactive monitoring of transformers and other equipment to improve reliability, and save operation and maintenance costs.

As a lower cost, rapid deployment hard-wired secure communication platform, the Series 5 system is an alternative solution to costly fiber-laying or potentially insecure wireless solutions. The Telkonet iBridge units provide a secure link between the circuit breaker monitors and the data collectors in the control house, and are widely used for online dissolved gas analyzer and substation transformer monitoring. With these latest additions, a substation can be installed with the Series 5 platform within a single day.

Telkonet Inc. | www.telkonet.com



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Digital Multimeter

Fluke Corp. published a series of application notes to help electricians and electronics professionals do advanced electrical testing with their Fluke digital multimeters (DMMs).

The Fluke 289 Industrial Trending Digital Multimeter has multiple features specifically designed for industrial technicians.

The Fluke 289 has automatic safety features like ghost voltage detection, easier logging with better display for on-the-spot troubleshooting, filters for variable-frequency drive (VFD) output readings, and on-screen help. Other capabilities built into the Fluke 289 are saving, recording and TrendCapture. The Fluke 289 DMM provides the usual measurement functions, such as Vac, Vdc, ohms, capacitance, Aac and Adc. For these, the user can have the meter monitor a circuit while the technician is busy elsewhere.

The 50-W function has the ability to measure low resistances with 0.001-Ω resolution. Also, the measuring circuit uses a much higher measurement current than normal ohms functions, making low-resistance readings more accurate in high-noise environments. This safety and accuracy function clearly identifies live conductors among those showing ghost voltage, which appears on unconnected wiring in close proximity to live conductors. With a low-pass filter, users can monitor the output voltage and frequency of an adjustable-speed motor drive accurately, while rejecting the higher-frequency output voltages that often confuse lesser meters. The new "(i) info" button provides a convenient alternative to the need to carry a manual or reference card around. Just select the desired function, highlight it in the menu, and press, "(i) info" to see a brief description of the function and its use.

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The new high-load formulation of Vista XRT provides control of kochia, including ALS- and dicamba-resistant biotypes. When used in combination with DMA 4 IVM, GARLON or TORDON specialty herbicides, Vista XRT also delivers consistent broad-spectrum control to a variety of other difficult-to-control broadleaf weeds and woody plants.

Acceptable for use on rights-of-way, Vista XRT can be applied to cool- and warm-season grasses. Vista XRT handles easily, even in hot climates, and is rainfast one hour after application.

Vista XRT is formulated by using a seed oil derived from naturally occurring seed oil, a proactive measure to reduce organic compounds and eliminate the use of petroleum distillates. This benefit helps ensure compliance in states that have mandated a reduction of Volatile Organic Compound emissions.

Dow AgroSciences
www.vegetationmgmt.com

Utility Light

Engineered Products Co. (EPCO) introduces a rugged utility light that is easily installed with only a screwdriver.

EPCO's new ProSeries Utility Light features an easy-to-install Octi-Junction Box that provides extra capacity for an additional power circuit. The eight mounting brackets on the Octi-Junction Box are in line with the 1/2-inch and 3/4-inch (1.27-cm and 1.9-cm) trade-size knockouts and eliminate a 2-inch by 4-inch (5-cm by 10-cm) stub-in. An integrated junction box cover features a "captive" set screw and posi-stop detent that expedites fixture installation. Also, a nickel-plated brass screw shell resists corrosion and is recessed approximately 1 inch (2.5 cm) to accommodate high-profile compact fluorescent or incandescent lamps.

EPCO | www.engproducts.com

Transformer Protection Relay

Schweitzer Engineering Laboratories Inc. (SEL) announces wide-area-measurement-based control in a transformer relay for the first time. This enhancement to the SEL-487E Transformer Protection Relay allows it to receive IEEE C37.118 synchrophasor messages from up to two phasor measurement units, time-correlate the information and take control actions based on local and remote messages. Remote angles, currents and voltages received in the serial synchrophasor message can be combined with local measurements for basic or advanced applications.

This advanced SEL-487E Relay communications technology allows customers to:

- Trip or start generators based on system load angles
- Control tap position based on combined values
- Send alarms based on changing angles
- Apply SELOGIC control equations to time-correlated remote measurements
- Detect system separation to initiate islanding control.

Schweitzer Engineering Laboratories Inc. | www.selinc.com



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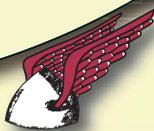
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Ripley | www.ripley-tools.com

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- Search for sales reps
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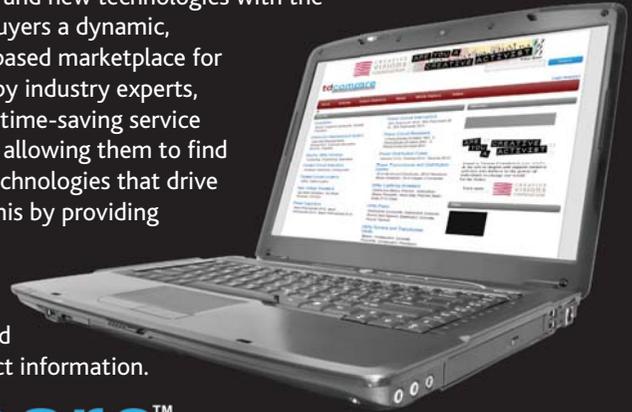
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Klein Tools and BlueVolt announce Klein Tools University, an online training resource for professional tradesmen in the electrical, construction, telecommunications and electronics fields.

Klein Tools University (www.kleintoolsuniversity.com) includes training on Klein Tools company history, products and product applications. Built on the BlueVolt mLMS learning management platform, courses come alive with a mix of video, interactive instruction and testing designed to engage the user and present information in a useful way.

The university, which is free for all users and available 24/7, is designed to expand with new courses to benefit the end-user. The mLMS platform provides powerful reports that allow Klein Tools to monitor training results in real-time and to ensure courses are effective and valuable.

Klein Tools | www.kleintools.com

Sonde Housing



Underground Tools Inc. unveils its new sonde housing. The 3/4-inch (19-mm)-thick access door on the sonde housing provides superior protection for valuable electronics. The housing is as much as 33% thicker than comparable units and features a slightly larger body diameter for greater wear resistance and durability.

The housing incorporates a seven-hole Vermeer pattern that is compatible with UTI pilot bits, including UTI Gold Series bits or Vermeer pilot bits. Custom adapters allow the housing to be used with all makes and models of drill rigs.

Underground Tools Inc.
www.undergroundtools.com

Power Trading

Open Access Technology International Inc. announces the patent application for the technology underlying OATI webAgent's Inter-RTO power-trading capabilities. The webAgent suite of products enables OATI customers to instantly identify trading opportunities between the North American ISOs and RTOs.

Using the patent-pending technology, the OATI webAgent solution completely automates the inter-market transactions to capture these opportunities in real-time. OATI webAgent is integrated with webTrader, OATI's front-to-back Energy Trading and Risk Management system.

OATI | www.oati.com

Silicone Coatings for Outdoor Insulators

The durability of POWERSIL silicone coatings for outdoor insulators is not affected even by many years of continuous use. That is the result of WACKER's outdoor endurance tests and current lab studies. They show that even after years of outdoor exposure to the elements, POWERSIL coatings retain their water-repellency and hence their beneficial electrical properties.

The POWERSIL portfolio of insulation materials for the T&D sector includes silicone coatings for porcelain and glass insulators. When conventional insulators are coated with POWERSIL, beneficial electrical properties are conferred on them thanks to the coating's water-repellent action (hydrophobicity). To assess the long-term stability of such coatings, WACKER performs accelerated weathering tests as per ISO 4892. For over 3000 hours, the coated test samples are irradiated with UV light and exposed to moisture. The state of the insulator coating is then determined by evaluating its water-repellent properties. The tests provide conclusive findings on the material's durability — data that could otherwise only be obtained from field tests spanning several years.

Wacker Chemie AG | www.wacker.com



Past

Present

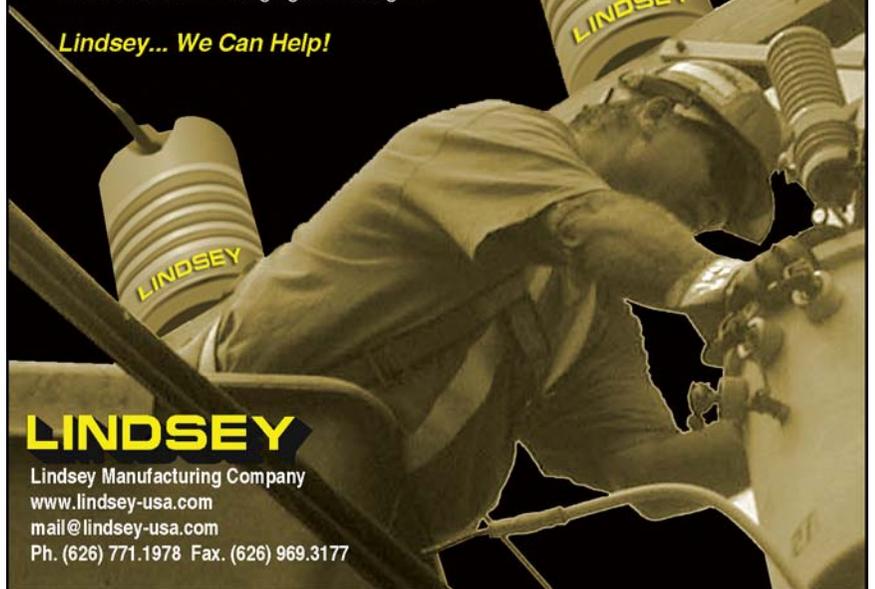
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Indoor Medium-Voltage Instrument Transformers

GE Digital Energy's new family of ITI Indoor Medium-Voltage (MV) Instrument Transformers includes voltage and current instrument transformers in the 7.2-, 12-, 17.5-, 24- and 36-kV classes. These new instrument transformers are ideal for operating meters, instruments, relays and control devices.

With the introduction of GE Digital Energy's ITI Indoor IEC MV family, utilities and OEMs in Latin America, Europe, the Middle East, Africa and Asia can now get their transformers from one source and be assured that the transformers have been designed, manufactured and tested in accordance with IEC standards. The new ITI Indoor IEC MV Instrument Transformers, available in custom designs, are compact in size and designed to use a minimal amount of space in MV switchgear.

The indoor MV transformers are manufactured and tested using state-of-the-art technology, helping to ensure high availability, reliability, consistency and shorter manufacturing lead times. The transformers are constructed of epoxy and polyurethane resins. Epoxy-resin transformers are manufactured using automated pressure gelation technology. Computer-controlled resin mixing and casting processes result in shorter manufacturing lead times and proven product consistency.
GE Digital Energy | www.gedigitalenergy.com

Graphic-Visualization Development Tools

GE Fanuc Intelligent Platforms, a unit of GE Enterprise Solutions, announces the latest release of DataViews 9.25, a set of high-quality graphic-visualization development tools for building custom applications. The new version includes new features that enhance performance of display updates, support the use of scalable text in input object templates and allow the setting of background color for scalable text objects.

DataViews 9.25 also introduces 64-bit operating system support for Red Hat Enterprise Version 5.3. This key feature enables developers to gain further performance from their application by having their DataViews-built components harness the 64-bit instruction set directly without the need of emulation. This is a key element for applications displaying a large amount of data in real time and ones requiring high performance.
GE Fanuc Intelligent Platforms | www.gefanuc.com/dataviews

Voltage Detectors



HD Electric Co.'s TAG voltage detectors are designed to detect voltage on distribution and transmission systems. When in direct contact with an energized conductor, the TAG emits an audible and visual alarm to clearly warn the user if the conductor is energized. Unlike proximity type detectors, TAG voltage detectors will not give false indications due to nearby energized conductors.

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Hybrid Vehicle Battery Test System

SAKOR Technologies Inc.'s Hybrid Vehicle Battery Test System can effectively perform all types of performance and durability cycling.

At the heart of the system lies a high-efficiency line-regenerative DC power source. During discharge modes, absorbed power is regenerated back to the AC mains instead of being dissipated as wasted heat.

Driven by a DynoLAB EM controller, the system inherits DynoLAB's ability to automate all types of performance, durability and continuous cycling operations, including full road load simulation. In fact, the system can function both as a battery tester and as a battery simulator. Integration with a HybriDyne Hybrid Driveline Dynamometer creates a system capable of testing complete hybrid drivelines and subsystems with or without actual batteries in circuit. The system may be configured to provide dynamic response just as would be seen in-vehicle. The simulator output remains repeatable from cycle to cycle, regardless of charge status, resulting in more consistent and accurate test data.

SAKOR Technologies Inc.
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A key factor in Smart Grid power distribution systems is the ability to automatically and continuously reroute power to minimize outages. Long-time provider of equipment designed to deliver electric power efficiently and reliably, S&C Electric Co. is helping its customers provide high electric service reliability and power quality on overhead power lines via a PulseClosing technology that offers a new alternative to conventional automatic circuit reclosers.

S&C's new IntelliRupter PulseCloser detects short-circuit events, such as a lightning strike or tree limb hitting the line, and interrupts high-magnitude fault currents. Then, the device applies very fast low-energy pulses to the power line to determine if the line is still faulted or if it is clear and service can be restored. The pulses allow less than 2% of the energy let-through compared to a typical conventional recloser, so repeated system-damaging stresses and voltage sags are avoided. The device minimizes the need for repair crews to respond to all fault situations and reduces the incidence of blown fuses that require replacement by utility crews. The IntelliRupter PulseCloser features base-integrated controls provided by a secure WiFi link that can be configured and operated from a crew truck up to 150 ft (46 m) from the device or via a remote connection to the utility's SCADA system.

Contributing to the long-term reliability of each IntelliRupter is the Cypoxy cycloaliphatic epoxy used to mold several of the device's components. S&C formulates its Cypoxy using a base resin and accelerator supplied by Huntsman Advanced Materials. Huntsman's Araldite CY 184 easy-to-process epoxy is a resilient thermosetting polymer with solid arc and track resistance, excellent mechanical and electrical properties and high heat resistance.

The Cypoxy produced with the Huntsman materials is molded by S&C via automated pressure gelation (APG) to produce vacuum interrupter units that house voltage and current sensors, as well as integral power modules that derive energy directly from the distribution line without requiring pole-top transformers. APG-molded Cypoxy brand product is also used for insulators. The cycloaliphatic epoxy is lighter and more chip-resistant than porcelain, resists damage from ultraviolet light and maintains its performance characteristics when exposed to temperature and weather extremes.

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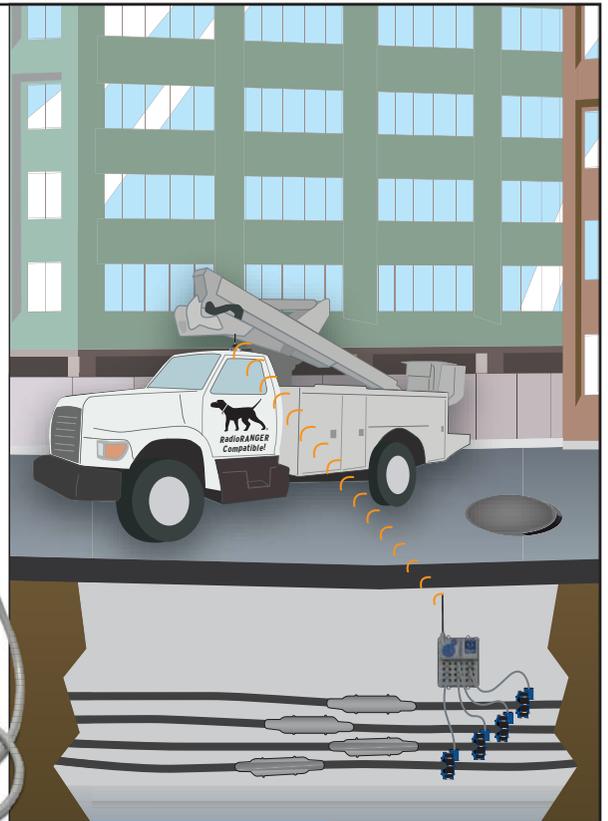
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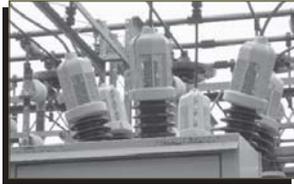
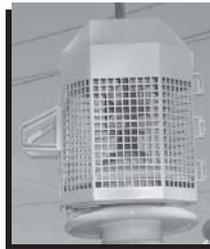
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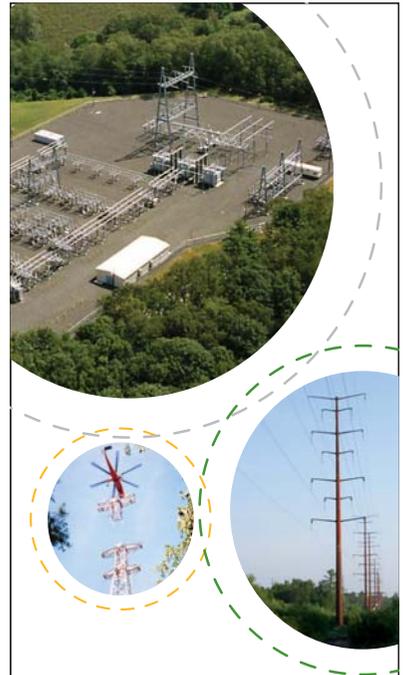
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Updating Infrastructure

By **David E. Schleicher**, PPL Electric Utilities



T **TRANSMISSION LINES ARE LIKE INTERSTATE HIGHWAYS** — a tightly interconnected network that moves large amounts of electricity over long distances from where it's generated to where it's used. PPL Electric Utilities owns 5000 miles (8047 km) of transmission lines — operated at 69 kV, 138 kV, 230 kV and 500 kV — in Pennsylvania.

Updating the grid is a critical factor in improving the nation's energy security and increasing the amount of intermittent, renewable energy generation available on the market, both of which are important public-policy objectives of the federal government.

Throughout the U.S., utilities are making significant investments in infrastructure to ensure they are able to meet the needs of tomorrow — better energy security for the nation, more clean energy on the market, safer and reliable electricity for customers. PPL Electric Utilities is embarking on a broad program of improvements that represents an investment of US\$2.5 billion in T&D infrastructure.

On a national level, the required investment in infrastructure will cost hundreds of billions of dollars. And with significant investments, come significant risks.

Multi-state, multi-utility approvals. Federal land crossings. Environmental studies. Siting concerns. Resource and material procurement challenges. Organized opposition. These are just a few of the factors that have the potential to delay a transmission line project or push it over budget.

The risks of doing nothing are far greater. Much of our transmission infrastructure was built in the 1960s and 1970s. In the area served by PPL Electric Utilities, electricity use has grown by nearly 500% since 1960. And despite the recent drop in electricity use as a result of the recession, the federal government estimates a continued increase in the use of electricity over the long term.

Our aging infrastructure will not allow us to meet this growing demand for electricity, maintain the high level of reliability our customers have come to expect, and accommodate new technologies that could make the grid more efficient and enable us to provide new services and options to customers.

The cornerstone of PPL Electric Utilities' expansion effort is the Susquehanna-Roseland project, a proposed 500-kV transmission line that will strengthen the regional grid across northeastern Pennsylvania and northern New Jersey. PJM Interconnection has directed PPL Electric Utilities to construct the Pennsylvania portion of this power line, while Public Service Electric and Gas is building the New Jersey portion.

Spanning more than 100 miles (161 km) in Pennsylvania and costing an estimated \$510 million, Susquehanna-Roseland is the largest T&D improvement project PPL Electric Utilities has embarked on in decades. The size and scope of this project, as well as the financial and credit pressures to accurately forecast cash flow and regulatory cost recovery, make risk management a critical factor in its success.

Because PJM has identified the need to have this line in place and operating by May 2012 to prevent overloads on existing transmission lines, there isn't much margin for error. Siting, permitting, design, procurement and construction must coordinate seamlessly for the project to be successful.

The project team started with a risk assessment. Conducting this assessment was critical to identify all the potential obstacles and put contingency plans in place to address them. The risk assessment also helped us gauge how likely it would be to meet the deadline and budget we set for the project.

The most valuable part of the risk assessment was getting all the subject matter experts — siting crews, environmentalists, engineers, accountants, lawyers and communicators — in one room. With everyone at the table we had a good sense of all the "what ifs" before we even began working on the project.

About 35 people on the project team worked together to come up with a list of risks and uncertainties that could delay the project or add to the costs. No stone was left unturned, as the team narrowed the list to 12 risks that were substantial enough to merit further evaluation.

Having the details on each potential hurdle has given us the tools we need to focus on mitigation strategies. Now we can take a proactive approach, handling obstacles before they become insurmountable. As certain risks were mitigated, we developed a critical path for the project and increased the likelihood of achieving our desired schedule. With ongoing monthly assessments, risk management has become an integral part of the work done on the Susquehanna-Roseland project. It's a practice that has become a standard part of the process at PPL Electric Utilities as we embark on a growing number of large-scale projects to upgrade our T&D facilities.

Having a detailed, forward-looking view of a project's potential risks will ensure the success of our infrastructure improvement efforts so that we can continue to provide customers with safe and reliable electric service. **TDW**

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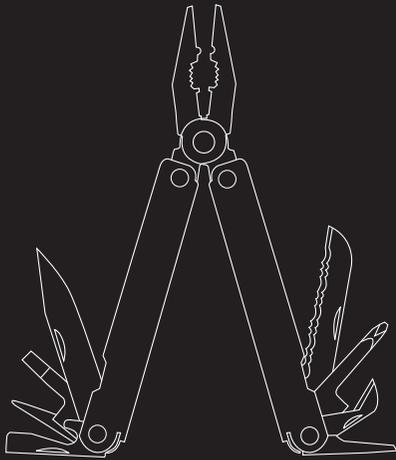
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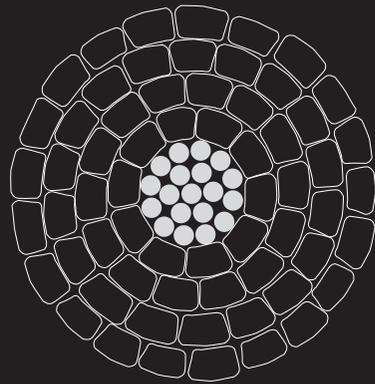
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