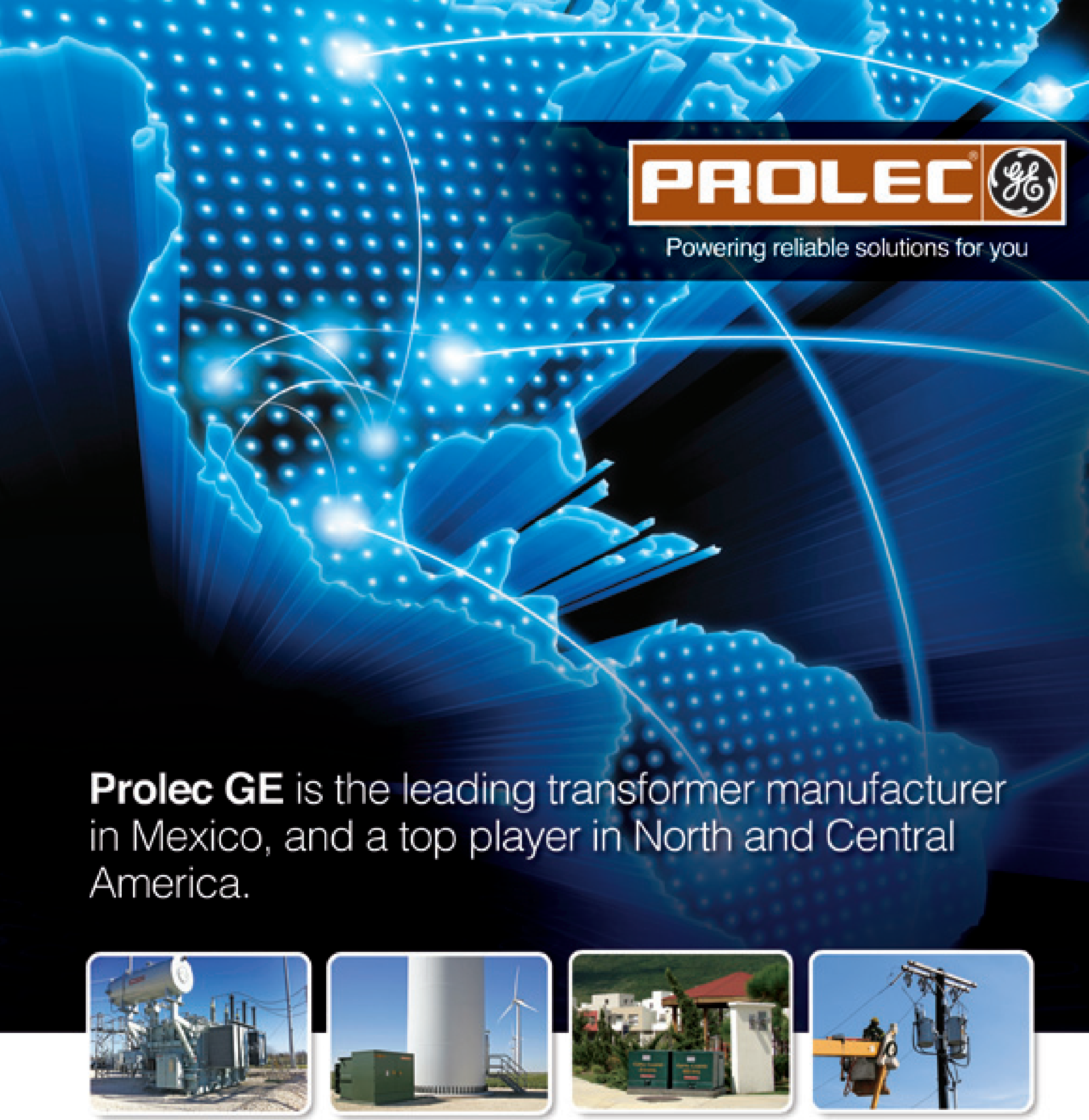
PP40010982
www.electricenergyonline.com

# Electric Energy T&D MAGAZINE

SEPTEMBER-OCTOBER 2014 Issue 5 • Volume 18


## DER integration is accelerating across the globe




Reliable solutions for the generation, transmission and distribution of electrical energy.

Tel.: +52 (81) 8030-2000 / Fax: +52 (81) 8030-2500 / 01800-377-6532 / sales@prolecge.com
**www.prolecge.com**


# Hard hats to black hats, Leidos knows utility security.

In just one conversation, you'll find that we speak grid engineering and security – fluently. Decades of utility domain experience and proven national security protection make Leidos the expert company to talk to about NERC CIP 014. Learn how Leidos translates your utility's new security requirements into full compliance.

leidos

ENGINEERING

**leidos.com/utility-security**

©Leidos. All rights reserved.

# Electric Energy T&D MAGAZINE

**Publisher:**
Steven Desrochers:
steven@electricenergyonline.com

**Editor in Chief:**
Terry Wildman:
terry@electricenergyonline.com

**Account Executives:**
Eva Nemeth: eva@electricenergyonline.com

**Art Designers:**
Anick Langlois: alanglois@jaguar-media.com

**Internet Programmers:**
Johanne Labonte: jlabonte@jaguar-media.com
Sebastien Knap: sknap@jaguar-media.com
Tarah McCormick: tarah@jaguar-media.com

**Electric Energy Magazine is published 6 times a year by: Jaguar Media Inc.**
1160 Levis, Suite 100,
Terrebonne, QC Canada J6W 5S6
Tel.: 888.332.3749 • Fax: 888.243.4562
E-mail: jaguar@jaguar-media.com
Web: www.electricenergyonline.com

***Electric Energy T&D Magazine*** Serves the fields of electric utilities, investor owned, rural and other electric cooperatives, municipal electric utilities, independent power producers, electric contractors, wholesalers and distributors of electric utility equipment, manufacturers, major power consuming industries, consulting engineers, state and federal regulatory agencies and commissions, industry associations, communication companies, oil & gas companies, universities and libraries.
Post Publication mail agreement #40010982
Account #1899244



Cover photo by Andy Wright Studios

*Electric Energy T&D* is proud to be a member of these associations



## SUPPLEMENT


swi
systems with intelligence
" Intelligent Video Monitoring Solutions for Harsh Environments "
SUBSTATION HARDENED VIDEO MONITORING SOLUTIONS
Video Analytics
Analog & IP Cameras
Thermal Monitoring
Video Management Software
-40°C
+85°C
Remote Access & Email Notification
Substation Hardened Digital Video Server
New TCAM1001
AUTOMATED THERMAL MONITORING
FEATURES:
• Remote monitoring of critical substation components
• Provide early warning of impending equipment failures
• Obtain temperature readouts of overheating
• Spot non-functioning equipment with low temperatures
• Instantly trigger audible and visual alarms
• Automated email notification
• Substation hardened equipment
SECURITY
ASSET MONITORING
VIDEO AUTOMATION
SAFETY
Systems With Intelligence Inc., 1215 Meyerside Drive, Unit #7, Mississauga, Ontario, L5T-1H3 Canada
Phone: +1-289-562-0126 Email: info@SystemsWithIntelligence.com
www.SystemsWithIntelligence.com


# POWERPOINTS

## Emissions Uncontrolled

Not long ago I asked my close friend, a tenured professor at one of the most respected centres of learning in North America, what he and his fellow academics felt about Canada as a country and how Americans might feel about Canada becoming the 51st State. I wanted his opinion, not only temporally but also from where the 'rubber meets the road,' as he had spent much time in several parts of Canada with me. Also, a large part of his duties with this American university was as a guest lecturer on the humanities. His travels saw him address many high level conferences throughout Europe, the United States, Canada, Asia, Australia, and Africa.

His answer was thoughtful:

> "For me and most of my colleagues, Canada is a country the United States, and many other nations, aspire to be like. For the U.S., it's like having a security blanket close to hand – content in the knowledge that yours is a sane and stabile country thriving in a generally troubled world – a country that is considered, and has proven, to be our closest friend and ally. I believe that becoming part of the States would be unhealthy to the relationship as those positive feelings of hope and trust that many of the American people have towards Canada would be abnegated.
>
> "Your country is a world leader in championing democracy, human rights, peace keeping, the rule of law, and the drive to sustain its natural resources. It's well known that Canada exhibits the courage to fight for and maintain all that is good and decent about this planet particularly in the area of protecting and saving the environment. To that end you ensure a bright future for generations to come."

I thanked him for his comments and told him how much they reflected my own deep belief in Canada.

And then something radically different happened here. Our government became anti-sustainability and a seeming opponent of the environment as it went hell bent for oil excavating Alberta.

In a fund-raising letter for the Canadian Alliance party in 2002, Stephen Harper wrote, "We're gearing up for the biggest struggle our party has faced since you entrusted me with the leadership. I'm talking about the 'battle of Kyoto' – our campaign to block the job-killing, economy-destroying Kyoto Accord.[1]

The tar sands are the largest contributor and fastest growing source of Canada's greenhouse gas (GHG) emissions. "No matter the cost, the Harper government has been relentless in its push for rapid, unchecked development of Alberta's tar sands," says Blair Redlin, a British Columbia based researcher specialising in privatization and P3s (Public-Private Partnerships); water trade agreements; and energy and transportation. "The devastating environment, social, and economic effects of tar sands development for the climate, water, boreal forest, and First Nations communities have done nothing to dampen the enthusiasm of the Conservative government." Canada's commitment to the Security and Prosperity Partnership (SPP) goal of 'energy security' for the U.S. is to increase production to five million barrels per day of tar sands oil by 2030. To live up to this, the government has been aggressive in removing all obstacles to tar sands expansion. In response to this, The Guardian UK reporter George Monbiot stated, "I am watching the astonishing spectacle of a beautiful, cultured nation turning itself into a corrupt petro-state. Canada is slipping down the development ladder, retreating from a complex, diverse economy towards dependence on a single primary resource, which happens to be the dirtiest commodity known to man."

Experts claim that by 2020 the Alberta tar pits will be dumping more pollutants into the atmosphere than the entire country of Denmark.

# YOUR SUBSTATION NEEDS AN INVESTMENT ADVISOR.

Are you sure the dollars you're spending today are buying you the substation you'll need tomorrow? Get answers from the experts—POWER Engineers. Our new NexStation suite of services will give you a head start on preparing for the challenges and opportunities of the highly networked and interactive substation that's just around the corner.

NEXSTATION


**Maximize your substation's return on investment. Contact POWER today.**

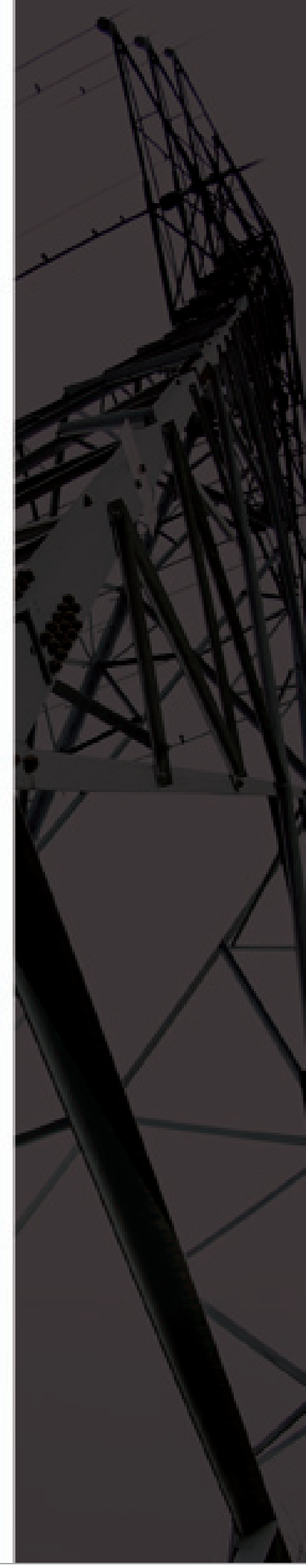
**CONTACT:** ALAN.SOWELL@POWERENG.COM

**VISIT:** WWW.POWERENG.COM/NEXSTATION23

To download our brochure or view a video animation of NextStation, scan code or visit WWW.POWERENG.COM/NEXSTATION23

POWER ENGINEERS

THE POWER TO DO IT ALL



Here's a little background to further clarify how we got to this point:

In February 2007, Bill C-288 was passed by Parliament. It was meant to force the government to *ensure that Canada meets its global climate change obligations under the Kyoto Protocol*. After ratification of the Kyoto Protocol by the Canadian Parliament, the government was legally committed to reducing GHGs by six per cent below 1990 levels by 2012. But largely due to tar sands expansion, Canada was 24 percent above and ended up 29 percent above its 'permitted' levels by the time the Protocol expired at the end of 2012. In spite of the fact the legislation required the government to prepare a detailed action plan within 60 days the government ignored it, citing economic concerns. This refusal to act has sent a signal to the world that Canada doesn't care about international treaty obligations, let alone climate change. "It is now clear that Canada will refuse to be sanctioned for abandoning its legal obligations," continued Monbiot. "The Kyoto protocol can be enforced only through goodwill: countries must agree to accept punitive future obligations if they miss their current targets. But the future cut Canada has volunteered is smaller than that of any other rich nation. Never mind special measures; it won't accept even an equal share."

During the closing days of the United Nations (UN) climate talks in Barcelona, Canada was handed both the *Fossil of the Day* and the *Fossil of the Week* awards. They were given by the Climate Action Network International (CAN-I) – a global coalition of more than 450 leading non-governmental organizations (NGO) who monitor progress at UN talks. According to the group, Canada was cited for doing *the most to block progress in climate negotiations*. World leaders at the conference finally had to agree that the goal of signing a legally binding climate treaty during the upcoming Copenhagen talks was no longer attainable.

The prospect of keeping the global rise in temperature below two degrees Celsius looks highly unlikely the way things are going. And Canada, for its part, is not on track to meet its own commitment to reduce GHG emissions.

Last year marked another record year for emissions. A recent report from the UK found fossil fuel subsidies around the world added up to about $500 billion in 2011 – on the order of five times the amount spent on subsidising renewable energy.

I love this country and this planet and, knowing what I know about the shortcomings of the federal government in the environment arena, was not in the least surprised to read the less than flattering quotes levelled at my country by former Irish president, and head of Climate Justice Foundation, Mary Robinson.* At the annual UN climate conference entitled the 19th Conference of the Parties (COP 19) in Warsaw she had a blunt and rather inconvenient message for global leaders and fossil fuel-producing countries like Canada:

> "If you're serious about preventing the worst of climate change, you have to leave that bitumen, oil, and gas in the ground."

Ms. Robinson also addressed the question of reducing oil and gas production in a country whose economic strategy is built around fossil fuel exports and made her feelings clear:

> "Moving to a low-carbon economy would be very good for Canadians' futures, and for everyone's future. And as well as that, we don't have a choice. We're running out of time.
>
> "How can Canadians not see that their grandchildren will share the world with nine billion other people (by 2050)? And I have no certainty at all that it will be a liveable world.
>
> "It will be a world of catastrophes over and over again. The 200 million people who may be climate displaced – where are they going to go? There will be no country that will be immune to this. If [the planet] becomes too dangerous, it will be too dangerous for Canadians, for the children and grandchildren of those alive today.
>
> "Canada is one of the countries that has benefitted from fossil fuel growth and has a responsibility to give leadership.
>
> "Canada has been a country proud of its development record. It gives a lot of development aid. Well, all that development aid will be wiped out by terrible climate impacts.
>
> "We're not, I think, a stupid race. I know that political timescales can be very short. But I believe that in these next two years:
> 2014 – We have to change course
> 2015 – When we need sustainable development goals and a robust, fair climate agreement.

We can still do it. We need a forward-looking leadership, and that won't come from Canadian politicians unless it comes from the Canadian people."

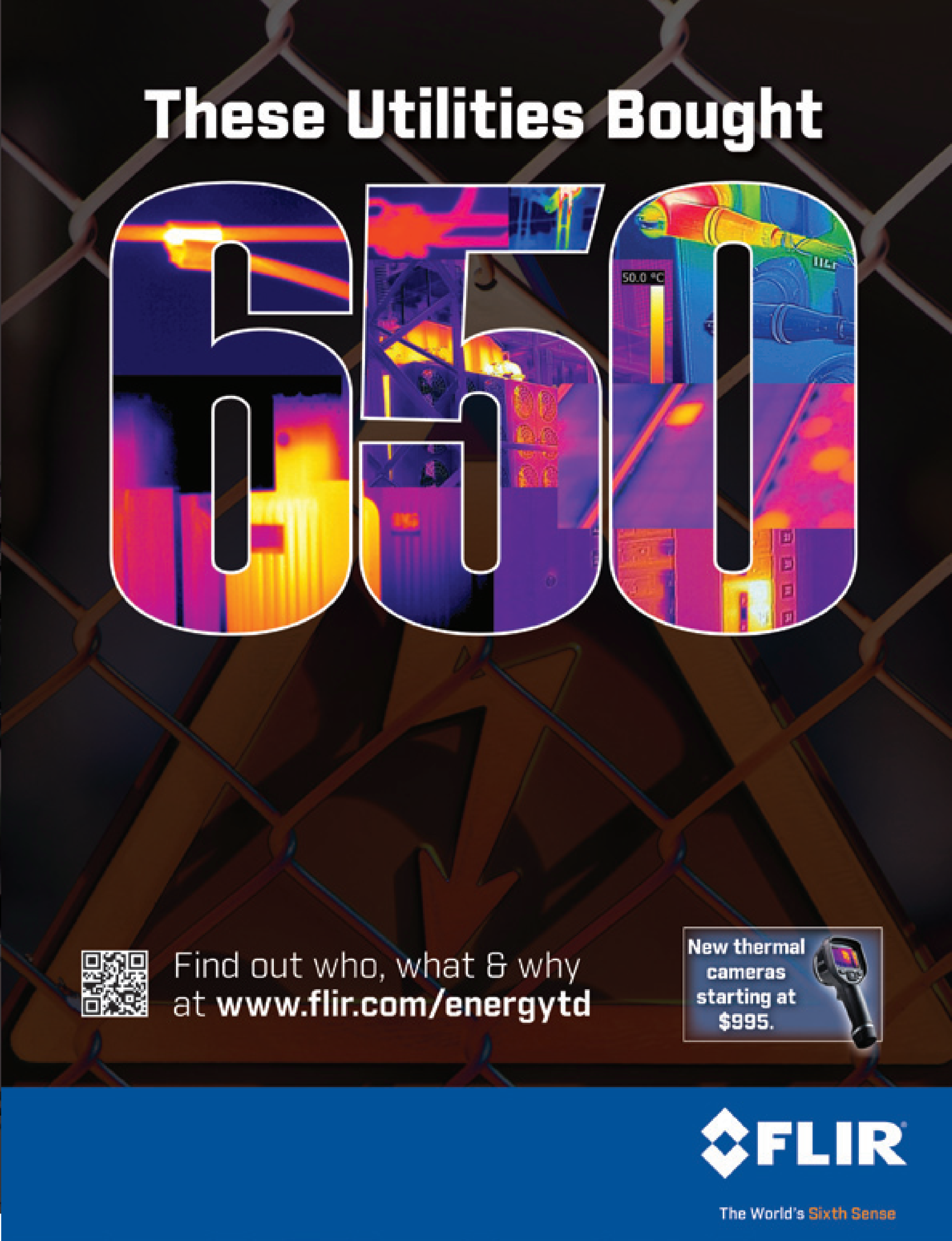
On the subject of implementing a carbon tax to help level the field Harper's attack was unequivocal: "This is crazy economics", he declared. "It's crazy environmental policy" that will "screw everybody." The attack ads the party prepared on the subject were so venomous and inappropriate, their own ad agency refused to handle them.[2]

I am one of many Canadian people who are totally perplexed as to why we have to suffer this constant attack on our planet – by our own government and am very pleased that Canada's provincial and territorial leaders have come together to build a national energy policy to put the brakes on emissions and climate change. I strongly urge the feds to take that leadership role they asked the electorate for and also do the right thing for the sake of my children and their children and so on.

*Mary Robinson served as the UN High Commissioner for human rights from 1997 to 2002, and argues that in the developing world, climate change impinges on the most fundamental human rights to food, water, and life itself.

[1] Sanger, T.,Graham Saul. "The Harper Government and Climate Change" *The Harper Record* (2008): 281

[2] Ibid: 295


These Utilities Bought
650
50.0 °C
Find out who, what & why
at www.flir.com/energytd
New thermal cameras starting at $995.
FLIR
The World's Sixth Sense

## Ventyx Joins Swedish Utility to Create One of the World's Smartest Electricity Networks

### Smart Grid Gotland to allow customers to control consumption based on energy prices and help utility meet European Union carbon emission reduction targets

Ventyx, an ABB company, announced it is joining an innovative initiative to create one of the world's smartest electricity networks, part of a development project entitled Smart Grid Gotland. As part of the project, Ventyx will deploy a comprehensive Distribution System Optimization solution encompassing network control, demand response management, demand forecasting and business analytics to support the project, enabling large quantities of wind and other renewable and distributed energy sources to be integrated into the grid, while maintaining reliability and providing better operational performance.

Ventyx is working with several partners on the project, including Gotlands Energi AB (GEAB), the utility serving the Swedish island of Gotland. GEAB is 75 percent owned by Vattenfall, one of Europe's largest generators of electricity, which is also a major partner in Smart Grid Gotland.

The project was initiated in response to the European Union's climate change target to reduce carbon emissions by 20 percent by 2020. Sweden plans to increase its renewable electricity production primarily through wind power, as generated on the Island of Gotland - the largest island in the Baltic Sea 90 km from the Swedish mainland - providing customers with low carbon, sustainable power supplies. After this Gotland pilot, the solutions and ideas could be transferred to larger-scale projects on the Swedish mainland and in other European countries, providing citizens with more reliable power and an opportunity to control their energy consumption and costs.

The distribution management system (DMS) software by Ventyx, integrated with ABB hardware, will be used to address bottlenecks in the distribution network that may restrict the flow from the wind turbines to consumers.

"Wind power is produced out in the distribution grid and, like solar energy, is highly variable, presenting challenges when it comes to power quality, surveillance and control of the grid," said Veijo Huusko, Head of R&D Portfolio Management, Vattenfall Nordic. "Using industry-leading network management software from Ventyx to create a more intelligent and efficient grid, we can increase the use of renewable energy sources, improve power quality and create added cost-savings for customers over conventional grid technology."

Ventyx Network Manager SCADA systems will cover one of the island's substation and its associated network - managing daily operations and helping to reduce the duration and frequency of outages through the use of smart meters and other equipment in the field. The Ventyx business analytics solution will analyze data from the SCADA/DMS/OMS system, and potentially other sources to help boost operational efficiency and reliability while reducing costs.

"The Gotland Smart Grid project is one of the world's most innovative and significant smart grid initiatives in demonstrating how modernizing electricity networks can support a greater variety of renewable energy sources while at the same time improving power reliability and customer control," said Jens Birgersson, head of the Network Management business at ABB, which acquired Ventyx in 2010. "It is a significant step forward in the development of a modern, sustainable society with the potential for it to serve as an international model for intelligent electricity networks."

Smart Grid Gotland is a cooperation project between Vattenfall, ABB, GEAB, Svenska Kraftnät, Schneider Electric and KTH, and is partly financed by the Swedish Energy Agency. The project was begun in September 2012 and will run to December 2015 and has three overall objectives:

1. cost efficiently increase the hosting capacity for wind power in an existing distribution system;
2. show that novel technology can improve the power quality in a rural grid with large quantities of installed wind power; and
3. create possibilities for demand-side participation in the electricity market, in order to shift load from peak load hours to peak production hours.

## DiversityInc Ranks Ameren Among Top 3 Utilities in the Nation

For the fourth year in a row, Ameren Corporation was selected by DiversityInc as a Top 7 Regional Utility for Diversity for 2014. Ameren ranks third on the utility list this year, recognized for creating an inclusive workplace, reaching diverse customers and having strong supplier diversity.

"Ameren believes that diversity in our workforce, our selection of suppliers and strong support for the communities we serve are critical to achieving the level of performance our customers deserve and the economic support our region needs," said Sharon Harvey Davis, Ameren's Chief Diversity Officer.

Ameren also ranked ninth on DiversityInc's list of Diversity Councils. The specialty list is new this year, and is based on effective best practices for councils that promote employee skills, knowledge and experience, and supplier-diversity progress.

The rankings from DiversityInc are the latest honor for Ameren. The company has also been ranked among the top 25 diversity councils in the nation by the Association of Diversity Councils, a top 100 military-friendly employer by G.I. Jobs Magazine and a top 50 employer by Woman Engineer Magazine.

"Earning a spot on one of DiversityInc's specialty lists for workplace diversity proves that management is paying close attention to the needs of their primary constituents - employees, customers and other key stakeholders," said Luke Visconti, CEO of DiversityInc. "Companies with great reputations attract the best and most skilled employees who then create and deliver the best products and services."

# Vista® SD Underground Distribution Switchgear; your clear choice in submersible switchgear.

*Three-Way Vista SD Pad-Mounted Installation*

**Vista SD is the industry's first practical solid-dielectric switchgear with a clear and visible open gap and field-replaceable bushings.**

S&C Vista SD Underground Distribution Switchgear features load-interrupter switches for switching 600-ampere main feeders, and microprocessor-controlled fault interrupters for the switching and protection of 200- or 600-ampere taps, laterals, and sub-loops. These elbow-connected components are encapsulated in an environmentally friendly solid-dielectric insulating material.

*Three-Way Vista SD Vault-Mounted Installation*

Vista SD Switchgear is available in ratings through 29 kV and 16 kA symmetrical interrupting. Vista SD Underground Distribution Switchgear is considerably smaller than traditional air-insulated gear; it can be installed exactly where it's needed. It's completely submersible and thus suitable for installation in subsurface vaults subject to flooding. Available in single-way and multi-way configurations

**Major features include:**

**Completely Submersible** — suitable for application in subsurface vaults subject to flooding.

**Easy-to-follow mimic bus and indicators on the front of the switchgear** — convey the position of each switch and fault interrupter and its isolating disconnect.

**Clearly visible open gap** — the easiest to see in the industry.

**Visi-Gap™ Load-Interrupter Switches** — provide three-pole live switching of 600-Amp main feeders.

**Visi-Gap™ Fault Interrupters** — microprocessor-controlled vacuum fault interrupters provide three-pole live switching and protection of 600-Amp main feeders.

*Single-Way Vista SD Vault-Mounted Installation*

**Vista SD UDS is offered with these 50/60-Hz IEEE ratings (IEC ratings in parentheses)[1]**

| kV | | | Amperes, RMS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Fault Interrupter | | Load-Interrupter Switch | | |
| System Class | Max | BIL | Main Bus Continuous Curent | Short-Circuit, RMS Sym. | Continuous Load Dropping, and Load Splitting | Short-Circuit, Interrupting | Continuous Load Dropping, and Load Splitting | Momentary and Three-Second, Sym. | Three-Time Duty-Cycle, Fault Closing, Sym. |
| 15 (12) | 17.5 (12) | 95 (75) | 600 (630) | 16 000 | 600 (630) | 16 000 | 600 (630) | 16 000 | 16 000 |
| 27 (24) | 29 (24) | 125 (125) | 600 (630) | 12 500 (16 000) | 600 (630) | 12 500 (16 000) | 600 (630) | 16 000 | 16 000 |

[1] *Other ratings are available. Contact your nearest S&C Sales Office.*

Scan this code now on your smartphone or tablet to learn more about Vista SD.

S&C ELECTRIC COMPANY
Excellence Through Innovation

To learn more about Vista SD, or other S&C products and services, visit our website. Or contact your local S&C Sales Office.

**www.sandc.com/vsd-ee**

## For Seventh Consecutive Year, Entergy Named as National Leader in Economic Development

### Company's efforts help attract nearly $21 billion in projects to Gulf South, potentially creating more than 9,200 jobs

Entergy Corporation (NYSE: ETR) has been named one of the nation's Top 10 utilities in economic development for 2013 by Site Selection magazine. The company was chosen for its efforts to help attract nearly $21 billion in projects, which could result in as many as 9,200 jobs across its four-state service territory of Arkansas, Louisiana, Mississippi and Texas.

The ranking may be viewed in the September 2014 edition and online at *www.siteselection.com*.

"We've dramatically stepped up our economic development efforts through the formation of a corporate business and economic development department that reinforces and supports the efforts our local economic development employees are making in attracting new business, retaining existing companies and helping them grow," said Mark Kleehammer, vice president of Entergy's Business Development Services.

"We're in a unique position here along the Gulf Coast," Kleehammer added, "and we continue to play an integral role in the ongoing industrial renaissance taking place in our own backyard. Not only will attracting business and industry help grow our business, it also will provide increased employment and economic opportunities for the citizens we serve."

Site Selection chose the top utilities based in part on jobs created and investments made in their respective service areas. Arkansas and Mississippi saw successes, Texas led the way with the creation of 3,183 jobs and Louisiana led in corporate capital investment activity with more than $17 billion planned.

The magazine recognized Entergy for its major system-level initiatives, which include its Strategic Sites Initiative, its Certified Sites Program, and a planned rebuild and redesign of the Entergy Site Selection Center - the company's GIS buildings and sites database. To help customer speed-to-market, a team of engineering project managers also was created.

More information on Entergy's economic development efforts can be found at entergy.com.

## Duke Energy named to the Dow Jones Sustainability North America Index for the ninth consecutive year

Duke Energy has been named to the Dow Jones Sustainability Index (DJSI) for North America for the ninth consecutive year.

"Being listed on the Dow Jones Sustainability Index for nine straight years clearly reflects our commitment to conducting business in a sustainable way even when confronted with complex challenges," said Shawn Heath, Duke Energy's chief sustainability officer. "Our 28,000 worldwide employees work to improve our business every day."

Since 1999, the DJSI has evaluated the sustainability of leading companies worldwide.

In selecting the top performers in each business sector, the DJSI reviews companies on several general and industry-specific topics related to economic, environmental and social dimensions. Among them: Corporate governance, environmental policy, climate strategy, human capital development and labor practices.

The index is compiled annually by S&P Dow Jones and Zurich-based RobecoSAM (Sustainable Asset Management). More information is available at *http://www.sustainability-index.com/*.

Duke Energy publishes an annual Sustainability Report that summarizes its efforts to advance energy efficiency, develop renewable energy, reduce emissions, and more.

The 2013 report is available online at: *http://sustainabilityreport.duke-energy.com.*

Some of the highlights covered in the report:

- As part of Duke Energy's $9 billion generation fleet modernization program, the company retired about 3,830 megawatts of older coal-fired units. That number will grow to nearly 6,300 megawatts of coal capacity retired over the next few years - about a quarter of the company's earlier coal fleet.
- The company has a new sustainability goal focused on ash management, which includes the development of a long-term strategy to manage the closure of coal ash basins across the Duke Energy system.
- Duke Energy's fleet modernization and environmental controls investments have helped reduce sulfur dioxide emissions by 84 percent and nitrogen oxide emissions by 63 percent since 2005.
- The company is on track to meeting its goal of owning or purchasing 6,000 megawatts of wind, solar and biomass energy by 2020.
- Since 2009, Duke Energy companies have distributed nearly 46 million energy-efficient light bulbs to customers, helping them save enough energy to power nearly 144,000 homes and offset the carbon output of 266,000 passenger cars.
- In 2013, Duke Energy recycled 25,719 inefficient refrigerators and freezers through its appliance recycling programs. Almost 26 million kWh of energy were saved last year - enough to power nearly 2,100 homes.

## SaskPower Reaches Agreement with Sensus to Recover Smart Meter Costs

SaskPower has reached an agreement with Sensus to recover the $47 million cost associated with the removal of smart meters. SaskPower will receive a $24 million cash refund from Sensus for all of the meters SaskPower had purchased - both those that were already installed and are now being removed and those that had not yet been installed.

SaskPower will receive an additional $18 million credit from Sensus for future metering products. Sensus will invest $5 million towards research and development of a next generation meter that meets SaskPower's specific needs. The new meter will meet Underwriters Laboratories (UL) standards and pass safety verification by an independent third party to ensure the meters function safely in Saskatchewan.

'We are committed to developing a smart grid that will serve the unique needs to our province and support our unprecedented economic growth,' SaskPower President and CEO Robert Watson said. 'A smart grid will bring significant benefits to our customers, including faster restoration of service following an outage, reduced carbon emissions and more timely and accurate billing.' SaskPower is continuing to remove the smart meters that have already been installed and expects to have all of the smart meters removed by the end of this year. There will be no impact on rates for Saskatchewan customers as a result of the current residential meter exchange program.


Bentley
Sustaining Infrastructure
THE
YEAR IN
INFRASTRUCTURE 2014
CONFERENCE
Next Practices for Advancing BIM
November 4 – 6, 2014 | Hilton London Metropole | London, UK
Join the world's leading executives in the world of infrastructure design, construction, and operations for this unique conference.
To learn more and to register, visit:
www.bentley.com/yiiconference/ElectricEnergy

# High Voltage Cable Solutions for North America

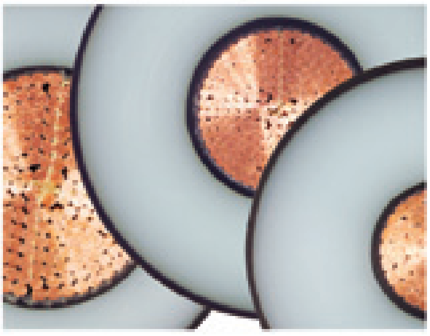
Dow Electrical & Telecommunications (Dow E&T), a business unit of The Dow Chemical Company, has more than 70 years of experience in the power industry. Its global team of specialists provides support to cable makers and utilities through both technical expertise and a world-class portfolio of insulation, jacketing and semiconductive materials for low, medium, high and extra-high voltage power cables. Sophisticated R&D, manufacturing, engineering and in-house testing/validation round out Dow E&T's overall offering and capabilities for the industry.

**Investing now and for the future**

When it comes to high-voltage (HV) solutions for North America, Dow E&T has nearly two decades of experience and is the only global producer of world-class HV compounds that can be sourced locally in North America. Understanding that utilities continue to invest in new and rehabilitated infrastructure, Dow E&T is making investments in its facility in Seadrift, Texas, to ensure continued supply of quality compounds made with modern equipment, process control systems and packaging, as well as logistics practices designed to meet or exceed industry standards for product cleanliness and performance.

Enhancements include:

- Continuous product quality measurement on the reactor
- World-class product transfer systems
- State-of-the-art metal detection and rejection system
- Additional tape inspection to improve continuous product quality assessment
- Majority of the equipment will now be in a climate-controlled environment
- New digital control system
- Pellet sorting capability



**Quality materials matter**

Cleanliness is extremely important in the production of highly reliable HV cables. Dow E&T strongly contends that quality materials matter in the construction of quality cables. With thousands of miles of new and upgraded transmission lines anticipated over the next several years, underground (UG) projects alone are expected to reach $236 million by 2015*. That's a huge investment across the value chain that must be protected through the use of reliable, long-life cables.

DOW ENDURANCE™ SC (super-clean) HV compounds help ensure the kind of quality that cable manufacturers and utilities can count on for years of durable and reliable UG cable function without the fear of contaminants that can lead to premature cable failure.

**The case for underground**

Renewable generation sources, shifts in generation fuel sources from coal to gas and aging infrastructure all influence transmission development that requires HV cable. Although overhead lines (OHL) will be used for many projects, the need for HV UG cable will continue to grow. The siting of OHL is challenging in certain regions due to rights of way, topographic obstacles or desired community aesthetics. In addition, UG cable installation results in:

- Increased protection against external factors such as weather, vandalism, etc., resulting in greater reliability
- Lower visual impact (better aesthetics) that increases value of surrounding area versus overhead lines
- Smaller right of way and faster approval of applications for installation
- Lower emission of electromagnetic noise
- Lower short- and long-term maintenance costs than overhead lines
- Lower power loss

And ultimately, underground transmission leads to faster deployment of more power and happier customers.

For more information about Dow E&T HV solutions for North America, call your Dow Representative or visit www.dowhvpower.com.

*Source: North American Transmission Line and Substation Market Forecast 2009 through 2020

®™Trademark of The Dow Chemical Company

Photo courtesy of Southwire

OVER **7 MILLION** FEET
OF HV UNDERGROUND CABLE.
**ZERO** FAILURES.* NOW THAT'S
PEACE OF MIND.

Sometimes it's what you don't see that matters. Our greatest value in helping you keep the power on lies beneath the surface.

Dow Electrical & Telecommunications has been providing SC (super-clean) insulation, jacketing, conventional and super-smooth semiconductive compounds for high voltage (HV) cable construction to the North American power industry for 15 years. And, we remain the only global producer of world-class HV compounds that can be sourced locally in North America.

Underground HV cable made from quality materials – proudly produced in the USA. Quality you can count on for long-lasting, reliable service in your new and refurbished power transmission infrastructure.

Ask us about our products and technical expertise for your next project. We help deliver peace of mind – for you and your customers.

*Data refers to cable installed in North America as reported by the manufacturer.

**DOW ELECTRICAL & TELECOMMUNICATIONS | www.dow.com**

For more information, go to www.dowhvpower.com.

# THE GRID TRANSFORMATION FORUM

Envisioning the 21st Century Grid

## The Inevitability of Renewable Integration

We are in discussion with Hugo van Nispen, DNV GL's Executive Vice President of Global Energy Advisory Services. DNV GL, the largest independent global energy consultancy, works actively to help utilities, grid operators, and governmental and regulatory organizations to transition to a safer, smarter, greener energy future.

**EET&D:** Let's jump right in. Do you really think that the integration of renewable energy into the grid is inevitable?

**HvN:** Yes. Obviously, we have been integrating large-scale renewables into the grid for many years now, so that is not new. However, had you asked me this question about *distributed energy and renewables (DER)* even five years ago, I might have answered differently. Today, it is all but certain. DER integration has taken hold in Europe already, where Germany is approaching 50 percent of grid resources. Across the Americas, the relative inertia of the past decades has given way to significant momentum.

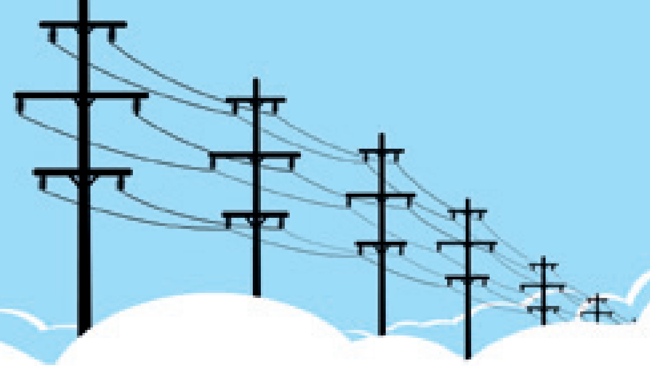
Several factors have accelerated the progress of DER integration in recent years. Through the 2009 American Recovery and Reinvestment Act (ARRA), the U.S. Department of Energy (DOE) has "invested more than $31 billion to support a wide range of clean energy projects across the nation." And the 2011 tsunami that led to the Fukushima Daiichi nuclear disaster has marshalled political will – dramatically in Japan and France; to a lesser degree across the globe – to deemphasize nuclear and shift to a larger reliance on renewable resources. In the United States, extreme weather events like Superstorm Sandy in October 2012 have driven national discussion questioning the status quo of the current, aging grid and demanding better ways to increase resiliency and reliability as well as to address any underlying climate impact. Regulatory mandates have played an increasingly active role in directing the use of renewable resources in the past five years. The 2014 California Public Utilities Commission's order to integrate historic levels of energy storage is requiring utilities and grid operators to find ways to comply within aggressive deadlines. In many states, including California, the average person no longer thinks of rooftop PV Solar as an eccentric's toy. Indeed, the culmination of multiple factors has resulted in levels of investment in generation, transmission and distribution infrastructure, which once made, cannot be lightly abandoned. Not only state and local but federal and international bodies are increasingly requiring specific proportions of renewable resources to be included in regional generation portfolios.

Perhaps even more significant than any of the factors above, economic factors in recent years have begun to swing in favor of DER – at least for consumers. It is cost savings that is driving more consumers to install rooftop solar, for example. Similarly, consumers are buying electric and hybrid vehicles because they find them reasonably affordable and viable transportation options (at least as long as federal and state subsidies persist). Hybrid and electric vehicle adoption is dramatically higher than five years ago, when adoption was nominal. According to a *Vox* analysis and data from the Energy Policy Information Center, as of July this year, 54,973 plug-in and battery electric EVs have been sold and 232,788 hybrids. EV sales have risen by 35 percent in just the first half of the year. As sales increase, manufacturers, businesses, governments and entrepreneurs are increasingly creating more underlying support infrastructure in the form of more available charging facilities, creating greater utility of these vehicles. As battery costs drop as manufacturing efficiencies increase, adoption will only rise further. Had financial drivers not come into play, perhaps even with all the other factors – shifting consumer attitudes, pro-renewables political clout, and various regulatory mandates – one might have argued that DER integration had not reached a tipping point. Today, that moment has passed. DER integration is happening – and the adoption rate is only strengthening.

In fact, this consumer demand for renewable energy represents a vast market poised to be shaped. It has unleashed on the energy industry a barrage of new competitors for the role of energy provider. Yet, even with the daunting challenge of adapting rapidly to an unpredictable shift of the familiar market and engineering construct that had worked effectively for nearly a century, it is creating tremendous opportunities – for utilities and other traditional grid stakeholders no less than for the newer players.

# THE GRID TRANSFORMATION FORUM

Envisioning the 21st Century Grid



Innovation has played a vital role in shaping the changes of the last five years as well. For example, innovation in energy storage is showing promise in resolving the intermittency limits of many renewable resources. Innovation has brought down costs of solar resources as well. Most significantly, innovation is going to play a crucial role in solving the challenges of integration.

**EET&D:** Let's delve more deeply into these challenges. What do you see as the main problems that must be resolved to integrate renewable energy successfully into electric systems?

**HvN:** The challenges are significant. And while the popular view in the Americas may be that renewable adoption is simple and held back merely by a lack of political will, the reality – as the industry itself is well aware – is much more complicated.

It's not merely the economic challenges of replacing the traditional legacy practices – in which a small number of centralized producers sell power to relatively passive energy consumers for predictable price-per-kilowatt schemes – with more complex practices. It's not just the engineering challenges of safely and reliably moving power across a newly decentralized grid architecture with multiple points of entry for generation and multiple smart technologies monitoring and controlling the flow of electrons. It's not even just the resulting complexity of the intersection of these two factors, economic and engineering, and the additional challenges this creates, such as clarifying who bears the burden for costs of infrastructure ownership and maintenance. It's all of this, plus the regulatory uncertainties that make the problem so vast and complicated. In June 2014, DNV GL published the results of our pulse survey of 200 U.S. electric energy industry executives. The challenge of integrating distributed renewable resources into the grid was their number one concern for the next five years. Regulatory uncertainty was also a top concern.

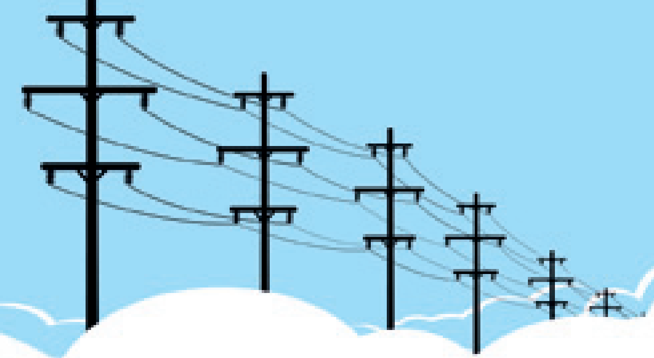
**EET&D:** The challenges are certainly daunting. I wonder how you see them breaking down for the different stakeholders in the utility industry.

**HvN:** Good point. While the same challenges may face the industry at large, the impact varies for utilities, regional grid operators, and government and regulatory bodies. Since system design, planning, and operation must take place on the local level, each of these players must forge a way to fulfill their local missions in a distributed energy future.

For utilities, the challenges are intensified by their traditional structures, which tend to separate generation, transmission and distribution functions. Continuing in this siloed approach will create serious obstacles to the integration of renewables. As we have seen, the economic, engineering, and policy challenges cannot be separated; they demand a holistic approach. For the electric industry in general, and especially for utilities, this will require change. The traditionally separated transmission plan and distribution plan will require a new approach, creating integrated resource plans (which will entail closer cooperation with regulators, as well). Utilities that can successfully align their internal business planning and the operation of their business units to support a new integrated reality will still face tremendous changes, but are ultimately more likely to succeed. Those that cannot muster the leadership to effect such sweeping change, are likely to flounder. Expertise that combines engineering, economic, and policy skillsets will play an increasing role in helping utilities define energy portfolios, manage investment risk, and scale into integration of renewable resources in affordable, effective ways. Additionally, utilities will have to manage a transition in which they have increasingly less control, but in which their regulatory obligations may not have changed, especially with respect to reliability. Stakeholders will have to tangibly address this inequity.

Independent grid operators may have an advantage in the new paradigm in that their perspective has always been holistic in terms of the entire regional grid. Across the United States, some of the most proactive and integrated planning is taking place at the ISOs. For example, in 2013, we helped develop the market for the PJM Interconnect to bring fast resources to market and reduce the costs of managing intermittency. ERCOT used our KERMIT tool to plan how much wind it would need to integrate into its market. Those are just a few I know of from our teams' work. Other ISOs are developing EV roadmaps and tackling a variety of tricky economic and engineering challenges. One particularly thorny challenge is that ISOs will increasingly need predictable visibility to the behind-the-substation conditions – an area that has traditionally been off-limits in terms of regulatory reach

**HvN:** Regulatory bodies such as PSCs and PUCs face a need for knowledge. They need to establish reliable economic guidelines and performance indicators, involving deep understanding of engineering challenges at a variety of technical levels, in order to better anticipate and manage the consequences of their rulings. And it's still early days. The majority of renewable integration work is in planning stages or not yet begun. Regulators face significant risk in finding reliable ways to extrapolate the impact of policy change. We see regulators addressing these risks and commissioning independent studies to model, simulate, and project potential impacts to a variety of proposed strategies. For example, in 2014 DNV GL developed energy storage valuation tools for the California Public Utilities Commission as it sought to place reliable boundaries around its mandates for utility compliance to California law.



And we provided the California Energy Commission analysis of the viability of five energy storage use cases they identified in the first half of 2014. In New York, this past September, we delivered a comprehensive examination of the current state of and future potential for integration of distributed energy resources across the grid. These states' governments, regulatory bodies and ISOs are providing leadership with careful gathering of facts, with simulations and modeling, and with a generally holistic approach that is being watched by energy stakeholders around the nation.

Finally, full-scale deployment of a truly distributed model will require the consumer to become a participant in future energy markets. This is perhaps the most complex component of the upcoming transition and will need to be accompanied by lots of education, before we can move to a truly DER-driven environment

**EET&D:** You mentioned innovation as a potential key to successful integration. Can you elaborate on what you mean by this?

**HvN:** Bill Gates described his approach to innovation like this: "I believe in innovation and that the way you get innovation is you fund research and you learn the basic facts." I think this is a relevant approach for the utility industry, which is at once one of the most innovative and one of the most skeptical industries in the world. The modern electric grid, providing near-ubiquitous reliable power in developed countries is one of the most sustaining commodities underlying modern society. As we evolve to a more sustainable and distributed future, the three factors "sustainability, reliability, and affordability" will remain an important way to assess the viability of our innovations. We see something of this approach in the research and proactive modeling being led by ISOs and regulators and by utilities themselves.

Yet innovation is not just the source of disruption; it also has a central role to play in resolving the challenges of integration for utilities, ISOs, regulators, and governments. At DNV GL, we invest five percent of annual revenue into innovation projects to address the industry's biggest challenges. One of our innovation projects is *Power Matching City*, established in the Netherlands. Here, the community's power needs are met through advanced, real-time load balancing technologies including efficiency and multiple renewable resources. Incorporating innovation means finding the latest advances in efficiency that can make an energy storage investment result in fiscal success rather than loss. Indeed, DNV GL is actively engaged with manufacturers and stakeholders to proactively test and model future energy storage options. Clearly, innovation is creating opportunities to build safer, greener and smarter future.

**EET&D:** Given the certainty of continued uncertainty, what can energy stakeholders do to reduce their risks and increase their ability to have successful outcomes from their renewable integration efforts?

**HvN:** You are correct. Uncertainty – be it economic, technological, or regulatory – is likely to continue. It's important to consider, for example, that the very definition of what constitutes a renewable resource will continue to change. Nuclear, hydro, energy storage, and even energy efficiency and demand response/energy management tools all may be seen as renewable resources for the electric capacity they are capable of contributing.

The scope of the challenge cannot be underestimated. We are talking about restructuring the flow of electrons, the flow of information, and the flow of money that supports it. Through it all, the essential achievement of the existing grid – delivering 99.999 percent reliability, with safety and affordability – cannot be compromised.

I would summarize a prudent approach to embracing the inevitable era of integrated renewables, as follows:

- Hedge risk with flexible portfolios and new technologies that actively balance energy supply/demand
- Invest in long-term planning that considers multiple possible scenarios for generation resources
- Learn from others' integration analysis and findings even as you shape your own portfolio suited to available resources, terrain, load size and shape, and distinct economic factors
- See innovation as solution as well as disruption
- Weigh all innovation against the vision of a reliable, affordable, cleaner grid.
- Take a holistic approach that considers the engineering, economic, and policy pieces of grid planning

**EET&D:** Thank you for sharing your thoughts on this compelling issue.

**HvN:** My pleasure. I appreciate the chance to participate in the Future Grid Forum. It's a valuable venue for stepping back and examining the energy issues that will build the foundation for the business climate of the next century.

# GREEN OVATIONS

Innovations in Green Technologies

# Smart Cities Address an Urgent Need

## As urbanization grows, sustainable practices become crucial

By Gilles Betis, chair, IEEE Smart Cities Initiative

One intriguing aspect of human nature is the knowledge that we can shape our own future. Yet failure to do so leaves us at the mercy of external forces and unintended consequences.

This is a critical issue today as populations grow and become more urban, while climate change, energy challenges and myriad regional trends threaten to overtake us. We have an opportunity – in fact, an urgent need – to discover and implement sustainable living practices in our cities.

As people around the world move from rural and sub-urban areas into urban centers, it's clear that, collectively, we'll need to apply ambitious levels of fresh thinking, long-range planning, and focused investment to maintain and even improve the quality of city life.

This will require people, government, the private sector and technology to optimize and coordinate myriad functions, from government to commerce, from mobility to security, from infrastructure to the arts. We'll need to address how urban dwellers access education and healthcare, how (or if) they commute, whether they feel secure and, ultimately, whether they live fulfilling lives.

Accomplishing all of this will depend, to a degree, on Smart Grids and successfully leveraging the vast and complex network of devices and systems known as the Internet of Things. But these are just two components of a Smart Cities vision. This is not a utopian vision, but a matter of great urgency as the world's population grows and becomes more urbanized.

The good news is that, today, we already have much of the technology needed to accomplish such a quest. The greater challenge, in my view, is making the needed cultural shift to succeed. Seizing the day is imperative.

Thus in this brief article, I would like to describe the IEEE Smart Cities initiative, which is our means to seize the day, and how it can address this global challenge.

## Drivers

As the world's population grows – the current seven billion is forecast to double by 2050 – we'll have to do more with less. Providing clean water, nutritious food and meaningful work for all is a perennial human challenge; population growth, resource scarcity and urbanization compound the challenge.

Today, half the world's population – about 3.6 billion people – lives in a city. The number of city dwellers is forecast to increase to 6.3 billion by 2050. Half of all people in Asia will live in a city by 2020; half of Africa's population will live in cities by 2035. The economic, environmental and cultural sources of competition and conflict that inhabit every day's headlines will only grow in the future.

## Today's cities: big/small, old/new

The diversity of peoples, cities, infrastructure (or lack of it), resources, and priorities makes the effort to create Smart Cities a complex but promising challenge. The world's largest cities, populated by millions, face specific hurdles due to population, the scale of infrastructure and the inertia of entrenched practices. But more than half of all urban centers contain less than 500,000 people. Smaller cities may have fewer resources but they may be more nimble in affecting change. Scale at both ends of the spectrum present contrasting opportunities and challenges.

Cities in the developed world will have to transform themselves through a hybrid of old and new. Think of modern Rome, where basements lie atop antiquities, first floors originated in the Renaissance period and upper floors were built in the 19th century. Incorporating intelligence in such circumstances will spur innovation. In contrast, new cities in the developing world may swiftly adopt the latest technologies and leap-frog ahead in competitiveness, shifting the balance of global economic power. Consider the potential for cities in India and Africa to rival or surpass the productivity of cities in the United States and Western Europe.

## Defining the Smart City

Guadalajara, Mexico, with 4.2 million people in the metropolitan area, is Mexico's second largest city, and the first city selected to participate in the IEEE Smart Cities initiative, based on the following criteria:

- Guadalajara has a concrete plan and funds to become a Smart City (Ciudad Creativa Digital project)
- It has a local constituency that welcomes IEEE's involvement
- Local authorities are willing to lead and share their experiences and lessons learned
- The city has a local IEEE chapter and section to provide support and accountability
- Local universities and industry are committed to supporting the initiative

Guadalajara will leverage existing strengths such as a high-tech sector that's particularly focused on digital media and has launched the Ciudad Creative Digital (CCD) initiative, which could have Smart City-related implications. Besides high-tech commerce, Guadalajara is focused on improving many prosaic city services, including government operations, transportation, security and telecommunications, even parking and waste management.

I cite Guadalajara, but two new cities – Wuxi, China and Trento, Italy – were selected last July in IEEE Smart Cities initiative. Every city will approach 'smarticizing' differently, based on local resources, strengths and priorities, but they must apply for participation and they must meet our basic criteria to join IEEE's effort.

Why these specific criteria? Because nurturing well-qualified efforts to create smart cities can plant the seeds of change on a global basis. Nothing persuades others to follow as well as success.

By selecting a diverse group of cities around the world we hope to develop a flexible tool kit of best practices. And IEEE will provide a platform for sharing these practices through its Open Data Framework to encourage other cities to follow suit. This effort will include the creation of online tools and courses for engineers, city planners and others who will put these concepts and technologies into practice.

The creation of metrics for performance in every sector of a smart city will be critical to demonstrating measurable value and quantifiable benefits in order to justify investments to 'smartify' a city.

## Mobility ≠ transportation

Doing more with less in various urban endeavors requires new thinking. Consider transportation. One can optimize an existing system, but urban transportation, for instance, faces physical limits. A city can't build itself out of congestion. Instead of moving people more efficiently, we're thinking in terms of allowing them to access value by moving from 'transport' to 'mobility.'

The result could transform 'mobility' into 'de-mobility.' In relevant cases, intra-urban teleconferencing could replace commuting. Or cars in the city – to the degree they're necessary at all – could be communally owned and available based on timely need. Such fresh thinking could change a city's approach to future infrastructure investments.

## Smart cities, smart grids, the Internet of Things

In creating Smart Cities, the optimization and coordination of energy-driven functions, as well as the notion of networking devices and systems relies on aspects of Smart Grid and/or the Internet of Things.

Smart Grid and a Smart City, however, are not synonymous. Smart Grid is just one of many elements, though a fundamental one, that will create a more de-centralized, inter-connected energy platform for a sustainable city. Both ideas embrace the need for and the value of efficiencies. But, more importantly, both require coordination among myriad devices and systems and present challenges in data management.

Smart Cities and the IoT both rely on countless sensors, central and distributed processing for optimization and coordination, and actuators to match the needs of urban dwellers with their urban environment. Smart City, in a sense, is a microcosm of the more widespread, potentially ubiquitous IoT. These terms likely will become meaningless to people who rely on them. When you take a holistic view of connecting such complex systems, everything is related. And the technology itself should become invisible.

## Technology

It's important to understand that, based on developments in Smart Grid, the IoT and other areas, Smart Cities are possible based on today's known, commercialized technology. Of course, challenges remain.

One challenge is also an opportunity: while the requisite technologies for Smart Cities exist, they need a focal point for coordinating and deploying them. Smart Cities can provide that focus. Still, complex systems – and systems of systems – need designing. We have yet to establish best practices in this endeavor. The next frontier will include designing value-added services that people need, based on the operations and resulting data of a Smart City. Apps will proliferate in this environment.

Many standards sensors, communication networks and control systems are already in place, but gaps are being identified and addressed. For instance, IEEE P2413 Draft Standard for an Architectural Framework for the Internet of Things is under development to define an architectural framework that will support cross-domain interaction, system interoperability and functional compatibility among devices and systems.

This will fuel the growth of IoT-related value – a direct boost to Smart Cities. Standards, of course, lead to the economies of scale that aid adoption and provide a platform for the entrepreneurial creation of new, valuable services.

## Cultural shifts needed

Amid the technology talk, however, it's critical to remember that Smart Cities are a human-centric endeavor. People will benefit from data-driven, optimized systems and the layer of services that ride atop them. In fact, people will provide data to an optimal Smart City through social media and other means. In exchange, they'll receive quality-of-life benefits. In short, Smart Cities imply Smart Citizens.

The cultural shift to widespread adoption of Smart Cities will take time, perhaps a generation or two. Awareness of IEEE's Smart Cities initiative may lead people to demand that their leaders pursue such an initiative, which can be incentivized by public policy. When people see, by example, the value in running an efficient, sustainable city with improved quality of life and the economic growth that goes with it, they'll seek the same goal.

## Conclusion

We believe that cities around the world will need to attract talented, productive people to create a vibrant economy and high quality of life that will further drive the trend toward Smart Cities. This is a daunting challenge. The hurdles cannot be underestimated. Yet it also promises a flowering of intelligent urban living that can become a model for the 21st century.

### Further reading, other resources

The IEEE Smart Cities initiative homepage:
http://smartcities.ieee.org/

What's new in Smart Cities:
http://smartcities.ieee.org/whats-new.html

Further reading:
http://smartcities.ieee.org/articles-publications.html

Upcoming conferences:
http://smartcities.ieee.org/conferences-events.html

### About the Author

**Gilles Betis** is chair of the IEEE Smart Cities Initiative and leads the Urban Life and Mobility action line of EIT ICT Labs. Gilles has been involved for more than 20 years in the design of complex systems, first in the field of military air-defense and then in transportation systems.

Never Say Never


*Reliance Ethernet from ComNet*
*Severe-Duty Ethernet Transmission Equipment*

**Reliance** is designed to meet the **extreme demands** of the **PT&D, utility** and **industrial markets. Reliance** products are IEC 61850-3 & IEEE 1613 compliant, made in the USA and backed by a Lifetime Warranty.

The **Reliance** line proves there is a **cost-effective transmission solution** for use in the **most severe operating environments.**

comnet
Communication Networks

MADE IN THE USA
LIFETIME WARRANTY

For more information on Reliance products, and ComNet's complete line of fiber optic, copper and wireless connectivity and network solutions:

Visit: comnet.net /register.html
Email: info@comnet.net
Call: 1-203-796-5300
Toll Free: 1-888-678-9427

# From Research to Action

## Beyond the Substation Switch: Effectively Managing Field Networks and Devices

By Galen Rasche, Senior Program Manager, Power Delivery And Utilization Sector, EPRI

The reliable and efficient delivery of electric power increasingly depends on information technology (IT) and communication infrastructures. This information infrastructure supports the control of operational assets and the monitoring of electric grid and equipment health. As more IP-based networks and devices are deployed, managing the information infrastructure will become crucial to providing high levels of security and reliability in power system operations.

Management of this information infrastructure layer requires connectivity and analytics to support both IT and operational technology (OT) assets in a unified manner. For example, once you have established a centralized network operations center (NOC) and substation local area networks (LANs), how do you monitor/manage the intelligent electronic devices (IEDs) on the LAN? Tools are currently available to manage the network equipment of power delivery systems, but there is a distinct gap in the field in which the tools are unable to gather system health or alarms from the field devices, remote terminal units (RTUs), and IEDs. A scalable, vendor-neutral solution is needed for integrated network, system, and security management of operations systems.

Network and system management (NSM) provides a solution to this challenge. It typically is viewed as having two functional components – monitoring and management:

- NSM monitoring provides the capability to acquire information related to the operational aspects of a communication infrastructure. This information can be used for network design optimizations, security event detection, communication anomaly detection, and other purposes.
- NSM management provides the capability to control key aspects of the communication infrastructure and to resolve detected problems. An example of management is the ability to remotely disable a communications port on a switch.

NSM data objects provide the metrics, granularity and visibility for managing and monitoring both the network and the field devices. A *standardized* set of objects enables interoperability and proliferation of applications that can use the objects. Figure 1 shows the proposed NSM architecture for operations systems.

Applying NSM objects to power delivery systems would support several key operational objectives:

1. Integrated awareness of network activity, state and health within electrical utility networks
2. Uniform and logically consistent packet prioritization, service segmentation, and processing internally (Substation LAN) and externally (Substation-to-Substation Area Network, Substation WAN)
3. Effective monitoring, maintenance, traffic control, and logging for the electronic security perimeter
4. Security monitoring, control and management of end devices

To support these objectives, the International Electrotechnical Commission (IEC) developed part 7 of the 62351 standards series titled *Security through network and system management*. Within IEC 62351-7, the objects include both monitoring and management aspects. This is well aligned with typical IT network environment and network technologies that utilize both monitoring and management capabilities. These capabilities include the monitoring and management of:

- Servers used as general purpose computational platforms that are used for widely accessed applications such as web portals/pages, FTP, mail, etc.
- Hosts used as general purpose office/backend computers that are used by local applications as well as SCADA and EMS systems
- Intermediate systems such as firewalls, routers, and Ethernet switches, and
- Field devices such as IEDs and RTUs

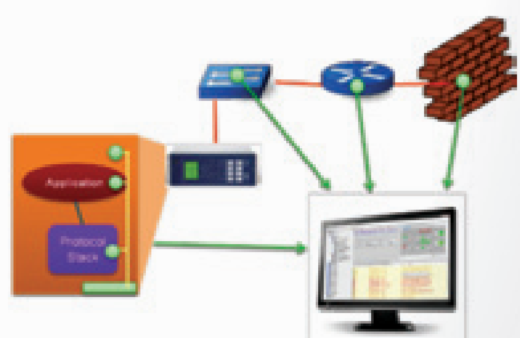


**Figure 1: NSM for Power Delivery Systems**

In 2012, EPRI began a multi-year research project to assist utilities and vendors in employing this standard. At the end of 2013, EPRI released report 3002000373 Network Security Management for Transmission Systems, which analyzed the potential for implementing IEC 62351-7 in a standardized and interoperable manner. As part of this research, an initial Simple Network Management Protocol (SNMP) Management Information Base (MIB) and information models were developed. These were used to validate the semantics of the standard.

The electric sector is beginning to recognize the advantages of applying NMS technology to power systems. This is especially true in the domain of substation LANs, where multiple vendors are developing NMS tools. While this is a step in the right direction, these tools are still limited in their capabilities and not interoperable. *However, interoperability will be the key to realizing the operational benefits of NSM technology*. The potential of NSM is not in the objects themselves, but in the applications that are built to manage these objects. These applications may be deployed in the substation network components, gateway devices, IEDs, or in the control center. Supporting interoperability avoids vendor lock-in and ensures that best of breed components can be utilized throughout a deployment.

A prototype tool currently being developed by EPRI demonstrates the value of this approach. The Substation Network Explorer (SNE) uses the IEC 62351-7 NMS objects to display:

## Substation Network Visualization

- Network topology
- IED configuration

## Asset Security Monitoring

- Key system resources
- CPU/memory/temperature
- Power supply
- Device clock

## Network Performance Analysis

- Substation network bandwidth
- Protocol traffic statistics
- Network latency statistics
- Switch/router status

## Deep Packet Inspection of Substation Traffic

- Protocol error detection
- Excess idle time and DOS detection
- Package loss or illegal header detection

## IEC 62351-7 SNMP Gateway

- Report all substation security in IEC 62351-7 MIBs
- Convert vendor-specific MIBs to 62351-7 MIBs
- Supports multiple NSM masters

Figure 2 shows the SNE architecture. Objects and alerts from the SNE can be directed to a control center NSM as well as a utility's security information and event management (SIEM) system.

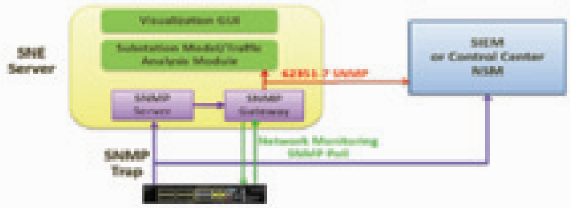
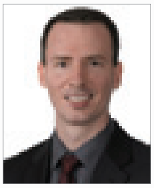



**Figure 2: EPRI SNE Architecture**

The IEC 62351-7 Edition 1 standard provides a first draft of abstract object models for performing network and system management functions to enable security architecture guidelines advancing secure access, reliability and network confidence. EPRI continues to engage with the IEC working group to refine the standard to support clearer semantics and interoperability. Additionally, ongoing lab testing of utility use cases is helping to identify any gaps in the current set of objects.

As more IP-based networks and devices are deployed in the field, managing these systems will become an increasing challenge for utilities. Applying NSM to power delivery systems can provide much greater situational awareness for utilities in both the operation and security of field systems, as well as fine-grained control over their networks and assets.



## About the author

**Galen Rasche** is a Senior Program Manager in the Power Delivery and Utilization (PDU) Sector at the Electric Power Research Institute (EPRI) and the program manager for the PDU Cyber Security and Privacy Program. He is experienced in the areas of cyber security, Smart Grid security and the penetration testing of embedded systems.

# Utility Security: Understanding NERC CIP 014 Requirements and Their Impact

By Rick Shumard and Steve Schneider

In the U.S. energy market, the ownership breakdown is a mix of regulated investor-owned utilities, municipal electric utilities, rural electric cooperatives, federal power marketing agencies and independent power producers. According to the U.S. Department of Energy, investor-owned utilities account for more than 50 percent of net generation and almost 80 percent of transmission. Public-owned utilities and cooperatives, along with the Federal power agencies, account for approximately 25 percent of net generation and almost all of the remaining transmission. Independent power producers account for the remaining 25 percent of net generation.

These entities are responsible for utility security, and they have a vast array of assets that require safeguarding. The three grids in the U.S. (Eastern, Western and Texas) are composed of more than 9,000 generation assets, 200,000 miles of transmission lines at 230 kV or above and 2,100 HV transformers. The high degree of interconnectivity within the grid reduces exposure to major failures. A single equipment component failure is unlikely to cause a cascading effect on a significant portion of the grid. No region in the U.S. has ever experienced simultaneous high-voltage transformer failures – just singular failures. However, the large and growing number of critical infrastructure assets and the ever-expanding list of threat profiles make single or multiple failures a significantly greater concern to overall grid reliability.

The environment in which utilities operate is also changing – ever-evolving and creating more areas where the grid is vulnerable to disruption. These changing areas can be viewed from both an internal and external standpoint, and both threat profiles require utilities to carefully plan and coordinate efforts across their organization. These profiles also include threats that could be physical or cyber-related (or both) in nature, further increasing the grid's vulnerability and the need for enhanced security to safeguard reliability.

## NERC and Critical Infrastructure Protection

Utility security can be viewed as the integration of national security into the power and electricity sectors. The protection of the largest machine ever designed, built and operated is critical to the quality of life and the economic future of everyone in North America.

Utilities are not alone in their effort to protect the reliability of the power grid. The North American Electric Reliability Corporation (NERC) is the regulatory authority with responsibility for the reliability of service to more than 334 million people. NERC's standards are directly aimed at encouraging or mandating steps for utilities in protecting their operations, helping ensure overall grid reliability.

NERC's authority has led to critical infrastructure protection (CIP) standards that guide utilities' planning and activities to eliminate or mitigate the many internal and external threat profiles. The CIP standards have evolved over time both in the scope of their focus and in the level of their authority. While cybersecurity continues to be an area of intense scrutiny and need for protection, focus has shifted in recent years toward the need for more intense physical security.

As shown in Chart 1, the U.S. government and NERC's approach to critical infrastructure protection stems from the National Infrastructure Protection Plan issued by the Department of Homeland Security. This plan was first released in 2006, revised in 2009 and revised again in 2013. The plan outlines how government and private sector participants in the critical infrastructure community can work together to manage risks and achieve security and resilience. The chart also shows the shift from primarily voluntary guidelines to more prescriptive standards in recent years.

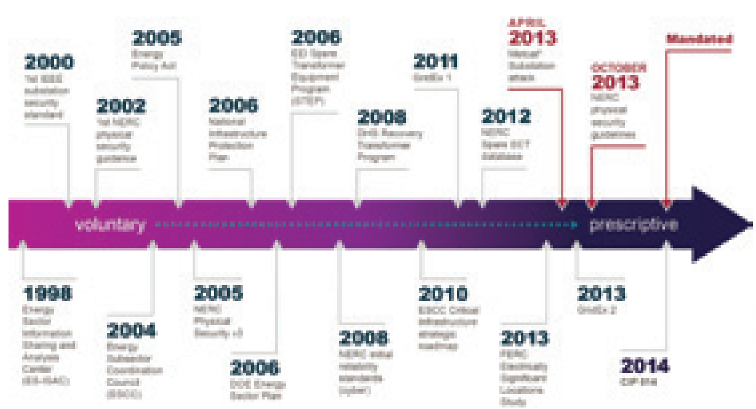



**Chart 1 – The Evolution of Critical Infrastructure Protection Standards**


Roxy, Miss September
Open for
Pin-up


TSTM VTPack TM
Ratio: 2.5:1
Sioux Falls, SD
Made in USA
Fully AMI/AMR compatible, including TWACS®
See a short installation video at www.ts-tm.com
* Even against lightning strike. Details on our website.
TWACS® is a registered trademark of Aclara®, an ESCO Technologies Company.
Football. A pretty girl. In a power publication?
Are we crazy?
Why would we do just about anything to get your attention?
Because converting to low-voltage metering is important! Lives are at stake. Not to mention revenue.
When you meter at low voltage through our guaranteed* VT Pack™, you'll...
Greatly reduce risk of flash-over, employee injury or death
Virtually eliminate costly meter failure
Eradicate AMI/AMR signal loss errors
Protect against lightning surge
Cut transformer install time to a fraction
Regain revenue lost to signal errors and meter faults
You'll wonder why it took you so long to notice. But don't thank us...
Thank Roxy.
TSTM INCORPORATED
www.ts-tm.com
TSTM
"I personally guarantee our products. Try any or all, risk free."
Greg May
President, TSTM

## NERC CIP 014 Standard for Physical Security

With an increased focus on physical security, the most recently proposed NERC standard, CIP 014, provides guidance to utilities in addressing the protection of key physical assets. The stated purpose of the new standard and its requirements is to identify and protect transmission stations and transmission substations (and their associated primary control centers) that if rendered inoperable or damaged as a result of a physical attack could result in widespread instability, uncontrolled separation or cascading within an Interconnection.

The CIP 014 standard was slated to be released on July 1, 2014. However, on July 16, the Federal Energy Regulatory Commission (FERC) directed NERC to include two changes to the proposed CIP 014 standard. In one of the changes, FERC requested that all applicable governmental authorities be able to add or subtract locations from a utility's list of critical facilities under requirement one of the standard.

With the new timeline for comments and replies after the public notice was uploaded to the Federal Register on July 16, the anticipated release date (at press time) is Sept. 20. Further changes or comments could delay the CIP 014 standard release again.

## A CIP 014 Standard Overview

Due to finite financial resources, utilities may not have all of the physical security protection they might otherwise like for their assets. This reality requires both appropriately prioritizing what assets are critical and then protecting them in light of the CIP 014 standard.

In general, the CIP 014 standard for physical security is a high-level threat and vulnerability analysis to uncover potential threats, weaknesses and the corresponding risks should an attack take place on a critical grid juncture. The standard provides a structured framework whereby utilities must perform an initial risk assessment. This assessment must be reviewed by an independent third party. The standard also then requires utilities to perform a tailored assessment and evaluation of potential threats and the associated vulnerabilities related to each identified critical location. And finally, the utility must develop and implement a plan to protect those identified assets from physical threat and have the plan verified by an independent third party.

| Requirement | Goal |
|---|---|
| R1 | Initial risk assessment– critical facility identification |
| R2 | Independent review of initial risk assessment of R1 |
| R3 | Coordination between operator and owner |
| R4 | Threat and vulnerability assessment |
| R5 | Development and implementation of physical security plan |
| R6 | Third-party assessment of plan of R4 and R5 |

**Chart 2 – Summary of CIP 014 Standard Requirements**

## Requirement One

The first requirement under the CIP 014 standard is for utilities to identify transmission stations, substations and control centers that – if rendered inoperable or severely damaged – could result in widespread instability, uncontrolled separation or cascading failures within an interconnection. This initial risk assessment covers existing and planned facilities within the next two years. Subsequent analyses have a 30- or 60-day timeframe, depending on whether transmission stations or substations were identified in the initial or previous follow-up assessments.

For the most part, generation plants and control centers are well-protected, leaving substations and transmission lines as the most potentially vulnerable assets. These assets are therefore measured against the criterion of their critical importance – what would happen if they were rendered inoperable or severely damaged. If the subsequent interconnection instability would be significant, then the assets must be included in the assessment. NERC has identified these assets as transmission stations or substations operated at or above 500 kV. Also included are substations between 200 and 499 kV that have three connected substations.

It should be noted that one of the two revisions directed by FERC applies under this requirement. The revision would allow applicable authorities to edit a utility's critical facility list, even if the facility doesn't meet the stated criteria. This provides insight that the critical list will continue to evolve based on new criteria or evolving threats. While centered on overall grid stability, additional considerations by government authorities could include the ease of replacing a transformer or whether a substation serves critical customers such as emergency or healthcare providers.

The timing of the initial risk assessment is dependent on the timing of the final regulation being announced (at press time, it is still pending). The standard would then include an effective date, and the deadline for the first assessment would be clear.

## Requirement Two

Under the second requirement of the standard, NERC requires utilities to have their initial risk assessment verified by an unaffiliated third party. NERC requires utilities to select either a registered planning coordinator, transmission planner, reliability coordinator or an entity that has transmission planning or analysis experience.

As NERC notes, it's critical for utilities to work with a third party that has transmission experience. It could also be recommended that the third party have a broader depth of utility knowledge along with cybersecurity capabilities to approach security in a holistic way.

Utilities may also considering a third party that is capable of working collaboratively on planning and assessing, as NERC allows for the third-party verifier in requirement two to assist the utility with the processes outlined in requirement one. This collaborative approach to the first two requirements can increase the efficiency and effectiveness of the overall process.

The CIP 014 standard's second requirement must be finished within 90 days of the completion of the initial risk assessment in requirement one.

## Requirement Three

The standard's third requirement mandates the sharing of assessment information and the critical nature of assets between transmission owners and operators. If the owner of a critical asset is not the operator, NERC requires communication between the two regarding the identification (requirement one) and verification (requirement two) of the particular station or substation's status as a critical asset.

This notification must take place within seven days of the completion of requirement two, and must include the date on which requirement two was completed, because that date serves as the beginning point for the operator to complete requirements four, five and six.

It is also required that the transmission owner inform the transmission operator within seven days should any assets be removed from the critical asset list during subsequent assessments.

## Requirement Four

After assessing and identifying critical transmission stations or substations, verifying their status and communicating that information to the operator if needed, requirement four of the CIP 014 standard mandates an evaluation of the potential threats and vulnerabilities of a physical attack to each transmission station, substation and control center identified under the first requirement.

According to NERC, the evaluation should include any unique characteristics of the location, any prior history of attack or past physical security events on similar facilities and any intelligence or threat warnings received from sources such as law enforcement, NERC, the Electricity Sector Information Sharing and Analysis Center (ES-ISAC) or U.S. federal and/or Canadian governmental agencies.

Leidos sees this evaluation as the basis of the strategic plan for physical security and should also inform a utility's infrastructure investment planning. It is critical to get this step right. Threat and vulnerability assessments combined with risk assessment are the foundation for a risk management plan. With the 'where' established through previous requirements, the idea behind the assessment is to analyze:

- Who or what can hurt us?
- How can we be hurt?
- When are we most vulnerable?
- What is the probability of that happening?

Answering these questions will lead to a wide range of responses among utilities, highlighting the importance for a customized evaluation approach for each utility and in some cases each critical location on a utility's list. Several current methodologies based on defense or emergency management agency protocols are available to make these evaluations. It can be helpful to work in conjunction with a third-party consultant during this phase of the standard as well to contribute to the efficiency of the next two steps. The third party should have a strong knowledge of the full spectrum and impact of this process – the overall utility industry, physical and cybersecurity, stakeholder and customer impacts, etc.

There is no definitive timetable or deadline specifically for requirement four. However, utilities should be aware that requirement five hinges on this evaluation and does have a deadline based on the completion date of requirement two. The two stages can be completed concurrently.

## Requirement Five

The fifth requirement from the NERC standard is for utilities to develop and implement a documented physical security plan that covers the identified and evaluated transmission stations, substations and primary control centers.

According to NERC, the plan should address resiliency or security measures designed collectively to deter, detect, delay, assess, communicate and respond to the potential physical threats and vulnerabilities identified during the previous evaluation. The plan should also include law enforcement contact and coordination information, a timeline for executing the physical security enhancements and modifications specified in the physical security plan and provisions to evaluate evolving physical threats and the necessary security measures to mitigate them.

Utilities may look beyond just a plan for NERC compliance and integrate these concepts as part of the their overall security programs, which should include physical and cybersecurity approaches, as well as accounting for other utility goals related to asset investment, growth and resiliency. The timelines contained in the plan should be realistic and coordinated with investment capabilities.

Requirement five must be finished within 120 days of the completion of the verification process in requirement two.

## Requirement Six

The final requirement in the CIP 014 standard is similar to the second in that it requires an unaffiliated third party to verify the utility's information and activities, except that the validation in this step is for the threat and vulnerability evaluation and subsequent security action plan. As with requirement two, NERC allows the flexibility to work with the same third party throughout the evaluation and plan development steps. This teaming approach allows utilities to complete requirement six at the same time as requirements four and five.

Under the standard, requirement six must be completed no later than 90 days following the completion of requirement five.

## Conclusion

In working with utilities for on-going security measures and in preparation for the CIP 014 standard, Leidos continues to recommend a holistic approach to utility security that is both proactive and reactive. Deterring threats – both physical and cybersecurity – and minimizing vulnerabilities is a proactive approach while mitigating the consequences of attacks is reactive.

Although utilities will continue to be confronted with new types of challenges followed most likely by new regulations, it's important for utilities to take a flexible, long-term view to utility security and position themselves to meet both anticipated and unforeseen events.

Long-term utility security planning focuses on the people who design, operate and maintain electric grids; the processes employed for developing plans, measures and operating procedures; the physical security materials and hardening measures; and integration of appropriate cybersecurity system technologies and applications. The long view of the future may start with CIP standards, but it should recognize that existing regulations will evolve as new needs and requirements arise.

### About the authors

**Rick Shumard** is vice president for strategic utility accounts with Leidos. He works primarily with investor-owned utility clients across the nation on projects that include grid planning and operations, transmission, substations, distribution systems, intelligent grid and physical security. Prior to coming to Leidos, Rick spent more than 28 years with the Electric Power Research Institute (EPRI) in advanced technology sales and applications. He has also held management positions with several western utilities with responsibilities in bulk power and distribution operations and engineering, generation planning, financial planning and rates and utility regulation.

**Steve Schneider** is chief solutions architect and director of technology integration at Leidos. Steve is tasked with leveraging and combining Leidos energy, health and national security technologies into new business models that meet complex new business requirements – a perfect example being the NERC CIP physical security regulations. Schneider also leads the Leidos microgrid business. He also has an extensive background and deep understanding of utility operations, having spent nearly two decades with Constellation Energy/Baltimore Gas & Electric. His oversight while there included the project management office, electrical and natural gas distribution and substation, transmission and strategic engineering.

# Limitations of Power-Flow Modeling for Voltage Control on the Modern Distribution Grid

By Jeremy Wilson

Historically, traditional voltage regulation techniques based on power-flow modeling have been sufficient for distribution system control: delivery of a nominal service voltage with a range of +/- 5% (e.g. 114V-126V) to an unengaged electric energy consumer with one-way power flow. However, the continuing modernization and automation of the electric grid brought about by the introduction of Smart Grid technologies require more advanced management and control than what has been available to utility operators in the past. One of the operational goals that utilities tried to achieve using traditional techniques is Conservation Voltage Reduction (CVR).

CVR is the operation of the electric distribution system in a manner which delivers voltages to consumers at or near the lower bounds of a utility's delivery standards (and nearer the nameplate voltage of consumer devices) in order to achieve peak demand reduction, energy savings, and reduction in technical and non-technical line losses.

Since 1970, CVR has been proven by many utilities to reduce energy consumption and lower demand by 1 to 3 percent. Typically, these savings have been achieved through the application of complex power-flow models and Line Drop Compensation technology. However, this approach is not well suited to the modern grid (e.g. distributed energy resources, etc.). New technologies have recently been introduced to the industry that allow utilities to realize the benefits of CVR without the constraints of traditional approaches. One of these new approaches leverages signal processing and adaptive control technology in an innovative way to implement intelligent voltage control.

Fueled in part by the American Recovery and Reinvestment Act of 2009, CVR has become an operational goal of a technology referred to as Volt/VAR Optimization or VVO (also known as Integrated Volt/VAR Control or IVVC). In addition to the historical energy benefits achieved through voltage reduction, modern VVO technologies also improve distribution system reliability and alleviate the de-stabilizing impacts of distributed energy resources (e.g. photovoltaics).

On suitable electric distribution systems, an application of CVR may achieve peak demand reduction and energy savings of up to 5 percent. The business case of CVR as an energy efficiency tool is significantly affected by the amount of voltage reduction that any particular technology can achieve through its control algorithms. A fifty percent increase in voltage reduction (e.g. an increase from two percent to three percent) can more than double the net present value of the business case.

However, traditional power-flow based methods of CVR –

1. Simple Voltage Reduction that uses Automatic Voltage Regulator Controls (AVR) to control peak-load voltage set points
2. Line Drop Compensation that measures the voltage drop along the length of the feeder
3. Distribution Management Systems (DMS), which use real-time switching information – while capable of achieving nominal levels of voltage reduction, have often done so at the expense of increased voltage regulator (i.e. on-load tap changing transformer or auto-regulating voltage transformer) tap change operations.

**Transmission v. Distribution**: Power-flow modeling is a powerful tool for system planning and load forecasting, allowing the complexities of the grid to be simplified in such a manner as to be manageable by a utility's distribution planning team and its cost effective computational tools.

Along with significant advances in computing power (and associated reduction in cost) however, manageable models have become more complex. What began as a simple model of non-time varying, linear circuit elements, has advanced to include non-linear elements and time-varying loads. The final piece of the solution puzzle of the power-flow modeling science is to include loads that are randomly allocated in both space and time. The resultant power-flow model is now written as a stochastic differential equation. This approach has achieved relative success in transmission management systems; however, these same models begin to suffer from burdensome intricacy and often become non-convergent when addressing the electric distribution system and its thousands of delivery nodes and increasing number of load inputs (e.g. distributed generation).

Regardless of how advanced power-flow models and computing resources may become, the approach outlined above will require that all circuit elements be known with precision (which for many utilities is not cost effective). Any change to customer demographics, load types, circuit switching or grid infrastructure will impact the accuracy of power-flow model results. On bulk power transmission systems, inaccuracies (of which there are relatively few) rarely impact the results of power-flow based control. However, on a distribution system where voltage and VARs are managed to a much narrower range (e.g. 2-3%) in order to gain efficiencies, these inaccuracies will lead to lost benefits and may impact system reliability.

**Set-Point Dispatching**: The majority of the advanced DMS solutions issue voltage set-points to field controllers based on the results of their power-flow calculations. These local devices then control their elements based on local measurements – not the circuit-wide measurements of voltage or VARs – leading to non-optimal decisions for management of the entire circuit. The consequence of this type of dispatch is that local field controllers continue to operate in an uncoordinated fashion, leading to hunting and dithering between voltage regulator elements; and, control instability arises when voltage regulators try to corrected voltage rise and drop caused by capacitor switching.

**Traditional Voltage Tap Changer Control**: Digital voltage regulator tap changer controls issue a tap change under normal conditions using three parameters: a local voltage set-point (target or voltage level), a control bandwidth and a computation timer.

This simple approach is merely a reactive decision to voltages that are influenced by random consumer behavior, and suffers from a fundamental problem: the tap changer will only make a decision when local voltages cross control bandwidth boundaries. The outcomes of this reactive decision are two-fold:

1. The tap changer will not bring the voltage back to the optimal target, even if the voltage has spent significant time near the boundaries
2. The tap changer may make unnecessary decisions for momentary voltage excursions beyond the boundaries.

As such, *maximization of voltage reduction is directly linked to the frequency of tap change operations.*

**De-tuning the System**: In order to reduce the increased number of tap change operations caused by set-point dispatching and traditional voltage control, several parameters are adjusted within the DMS or local control elements (specifically OLTC and voltage regulator controllers), effectively 'de-tuning' the optimization goals of the VVO solution. There are several primary de-tuning methods utilized for set-point dispatching of a VVO system, including:

- Decreasing the dispatch frequency of set-points
- Increasing voltage bandwidth
- Increasing the length of the computational timer.

Issuance of a new voltage set-points may cause an immediate tap change in a voltage regulator; therefore, many CVR/VVO solutions have reduced the frequency with which they issue voltage set-points. Voltage tap change frequency can also be reduced by increasing the voltage control bandwidth, or dead band. Increasing the length of the computation timer is typically used when system instability causes extraneous tap changes (usually due to capacitor switching or voltage rise caused by distributed generation). However, all of these methods are ineffective for optimizing voltage control to achieve energy and demand savings, as they decrease the amount of time spent at the optimal voltage level.

## Challenges Presented by the Modern Grid

Optimization of the modern grid requires more advanced management and automated control than has been available to utilities in the past. One of the primary focuses of grid modernization is to enable the integration of customer-owned distribution generation resources such as photovoltaics and wind power. There are many significant issues created by these new generation sources that can impact grid stability:

a) Random behavior caused by supply intermittency
b) Multi-direction power flow
c) Voltage spikes and sags
d) Extended periods of high voltage
e) Increased tap change operations
f) Increased capacitor switching.

The combination of the complexities grid modernization and the limitations of traditional power-flow based, voltage control regimes in achieving optimal voltage levels without spiking asset operations and threatening reliability, have brought about the need for advanced, real-time solutions for intelligent voltage control.

As an alternative to power-flow modeling, which treats voltage fluctuation as an impact on circuit conditions, voltage fluctuations can be looked at as a process problem caused by demand, which is driven by stochastic (i.e. random) consumer behavior. This stochastic behavior, when viewed as a 24-hour demand profile, follows a pattern that is obvious to the human observer and utility load forecasters. However, from minute to minute, the demand behavior exhibited by consumers is random. The impacts of this behavior can be observed in real-time via the voltage signals created by the demand process. In addition to consumer (i.e.) load behavior and its influence on voltage, there are two other broad categories of behavior that influence voltage measurement on the grid:

1. The behavior of grid inputs (i.e. transmission sources, generation resources, distributed energy resources, etc.)
2. The behavior of losses on the grid structure

Over time, the impacts of these behaviors are reflected in the voltage signals measured on the distribution system. One example of this is the change in system voltage as load increases and decreases around the daily system peak.

Intelligent voltage optimization that leverages signal processing delivers more demonstrated benefits by way of its observation and extraction of behavioral information from voltage signals along an entire distribution circuit. Rather than making a decision based only on the voltage measured at a single control element, the resulting adaptive control decisions are made and executed based on that actionable intelligence and are not based on circuit modeling.

**Elasticity**: As previously stated, the main issue with the legacy approach to voltage regulation is that the AVR only makes a decision when voltage crosses a boundary threshold, turning the control decision for a stochastic process into a binary reaction. In order to more appropriately implement control of this process, control algorithms should instead use statistical control, allowing the voltage controller to make a decision based on the probability of the need for a tap change, rather than to react to a voltage change.

Combined with the behavioral information gleaned from the application of signal processing, this control algorithm provides several benefits over traditional methods, the first of which is that the VVO system makes only the decisions necessary to achieve the optimal voltage target. For example, it can identify momentary voltage excursions beyond the boundary threshold, perhaps caused by distributed generation (DG), and prevents reactions that would need to be immediately corrected after the voltage inevitably returns to within the control bandwidth. Similarly, the algorithm can identify when the voltage is beginning to trend outside of the bandwidth and can make a tap decision to maintain the voltage near the target without the voltage ever crossing the boundary threshold.

This process-based approach to implementing intelligent voltage control combines smarter and less frequent tap operations with more time spent near optimal voltage levels. It is innovative VVO that not only achieves voltage reduction, but also helps to improve distribution system reliability and to alleviate the de-stabilizing impacts of distributed energy resources. As the grid continues to modernize and automate, more such advanced approaches will be necessary.

## About the author

**Jeremy Wilson** started with Programmable Control Services, Inc. in 2003 as a Sales and Marketing Coordinator. Wilson quickly advanced through the company, holding a variety of positions. In 2012, he was on the founding team of Utilidata, Inc., where he serves as Director of Technical Sales. In this role, Wilson is responsible for developing partner relationships and alliance agreements with large utility clients and other smart grid vendors; working in partnership with regional energy authorities to advance regulatory framework for the implementation of Volt/VAR Optimization; and, product management of Utilidata's digital technology. Jeremy also makes frequent presentations at trade shows and educational conferences. Wilson graduated Magna Cum Laude with a BA from Washington State University.

# Crew-Care/Logistics during a Large Restoration Incident

By John Kullmann

A major storm has hit the area. Thousands, maybe even tens of thousands, are without electricity. The utility company must resolve the outage emergency as soon as possible – a large part of which involves crew-care logistics, such as how many people will be required, how many crews, where they will be lodged, how and what they will be fed, how information will be communicated to them, and countless other tasks.

The ability to accomplish these diverse, complex tasks can literally make the difference between customers having or not having electricity for days; between having satisfied customers complimenting the utility on its effective response to the emergency or screaming bloody murder about what a mess it made of things.

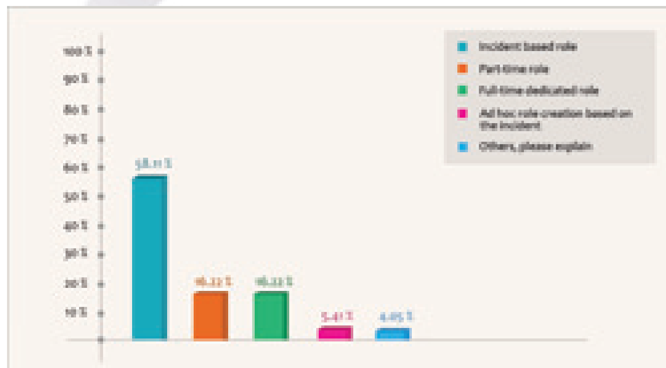
*So what are you going to do about it?*

To find out the answers, Macrosoft, Inc. conducted a study among key personnel from utility companies around the country.

The survey was conducted during August 2014 using an online survey tool. Some 76 individuals participated, representing a broad spectrum of organizations across the country, including investor-owned as well as municipal utilities and cooperatives. Macrosoft asked a comprehensive range of questions about crew-care logistics, with the opportunity to answer both closed (pre-determined) and open-ended (free-form) questions.

Their responses ranged from predictable, to surprising, to remarkable.

Let's start with logistics preparedness during a blue-sky day prior to a large-scale incident.  There is no doubt that utilities are cognizant of how important logistics is. Virtually all respondents (96%) say crew-care logistics is "very important" to the emergency management process.  But only about one-third of the companies have personnel responsible for crew-care logistics on a full-time or even part-time basis. Remarkably, even companies which have handled 10 or more incidents over the past year are deficient in this area with only 29% having full-time and 7% or part-time personnel.




This means that, for each incident, the people entrusted with this key function are literally a 'Hobson's choice.' Whoever is available, regardless of experience or knowledgeability level is engaged in logistics planning rather than personnel with crew-care management experience.

Regarding how the operations themselves are handled, about half of all study participants tell us their companies centralize operations, resources and logistics in one place, with the rest at separate locations. Not surprisingly, the nature and scope of each individual incident determines most companies' decisions regarding whether to centralize or disperse these functions.

In one respondent's words:

> *"We use ICS for significant response, so depending on how big a restoration effort we may have tactical leaders on the ground with the crews as well as a full ICS team at our corporate EOC – including all command and general staff"*

## LOGISTICS CHALLENGES

When asked what the single biggest challenge of crew logistics is, the two most frequent mentions are lodging and food.

## Biggest Challenge Crew-Care/Logistics Processes

Yet, despite their importance, a majority of utility companies do not have standing contracts with any companies or organizations which provide these essential crew care services.

Surprisingly, only 21 percent indicate they have contracts with hotels. Even fewer (19%) have contracts with catering/food services. Even for fuel, only 19 percent have contracts.

And, inexplicably, companies which handled the greatest number of incidents in the past year are less likely to have such contracts than companies which handle the fewest.

## Standing Contracts


Beyond these mainstays, most other challenges again relate to the unpredictability of each individual incident, and that circumstances during an incident can change while it is in progress, thus necessitating corresponding changes in crew logistics 'on the fly.'

This clearly underscores the need for logistics planning in advance and the development of immediate, comprehensive communications capabilities which, as information becomes available about the incident and what is needed to handle it enables managerial personnel to get everyone on the same page as quickly as possible.

## LODGING

Looking at lodging specifically, there is no clear direction to how it is accomplished: about one-third of study participants say hotel rooms are typically secured and managed locally, one-third say this is done from a central location and one-third say it varies – depending on the size and scope of individual incidents. The biggest bottleneck/issue with lodging is the most basic one; finding and booking enough hotel rooms for crew members.

Another is room distribution. As one participant notes:

> *"Occasionally, when the hotels give your rooms to other groups representing the utility, or accidentally (do so), it creates havoc and distractions trying to retain more rooms")*

Finding rooms in proximity to the incident remains challenging and, interestingly, the practical matter of physically getting room keys to crew members can be complicated.

If, as sometimes happens, hotel accommodations are not available, companies very much prefer that hard-shell buildings be secured for crew personnel. Two-thirds say they are either 'preferred' or at least 'acceptable' Mobile sleep trailers are well behind, but still 'acceptable' to about half, while tents are emphatically disliked.

## MEALS

For lunch the one meal certain to be needed during the work day, respondents strongly prefer that box/bag lunches be provided to crew members in the morning, with some feeling it would be better to deliver the meal to crews in the field (possibly so crews can have a hot lunch).

Loss of work time is the single biggest issue when it comes to feeding crews – which is why box lunches are seen as superior to buffet lunches or restaurant meals, both of which require time away from the actual work site.

## BASE CAMPS

Although opening a base camp presents significant logistical problems, the 'good news' is that they are not needed very frequently. About half the study participants tell us they have not had to open one in the past five years, and about four in five (78%) have done so less than once a year during this period.

But when base camps are needed, respondents are very clear about the components they consider most important, including:

- Site size/capacity (97% rate it 'very important')
- Location within the service territory (93%)
- Entrance/exit accessibility (89%)
- Security (82%)

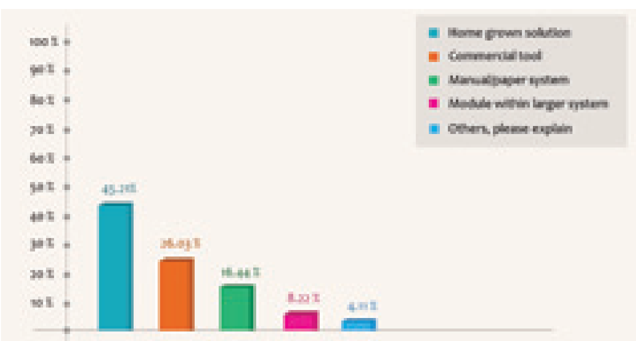
Though 82 percent rate security 'very important' (and 98% rate it 'very' or 'somewhat' important), a staggering 93 percent of study participants tell us their companies do not issue ID cards, wrist bands, or other such credentials. This obviously maximizes the risk that unwanted personnel can get into the base camp, or have access to work sites. There is a major disconnect between the perceived importance of security and company follow-through.

## HOW TO MANAGE CREW-CARE LOGISTICS

The single most-used method/process for managing crew-care logistics during a large-scale emergency restoration involves a variety of 'home-grown' solutions, such as SharePoint, spreadsheets, etc. While certainly not specific to utility outages, at least they are progressed from the 16 percent who are still using whiteboards and paper forms.

About one fourth (26%) use software solutions to quickly handle most crew-care logistical issues. 36 percent of the participating companies which handled 10 or more incidents over the past year are most likely to have such software.

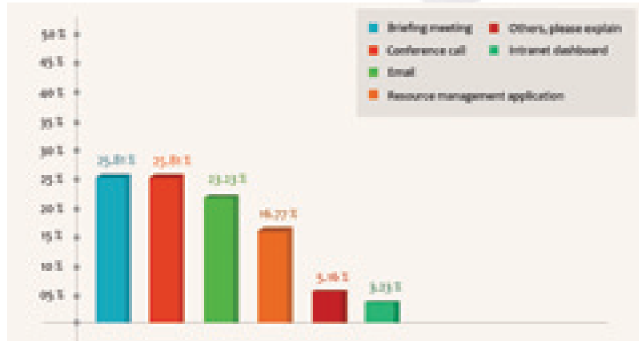
### Methods for Managing Crew-Care/Logistics




Communications-wise, crew-care/logistics instructions are mostly passed along by phone (36%) or email (25%), with text messaging well behind at 12 percent.

Given the companies' low percentage of software usage; it is hardly surprising that study participants are dissatisfied with their companies' crew-care logistics methods. Only one-third (34%) of study participants are 'very satisfied.'

### Communication Methods




This is clearly reflected by their suggestions regarding how logistics management communication be improved. Here is just a partial sampling:

*"Reduction in paper based communication of information to work force"*

*"Use electronic communication, consistently across the entire organization"*

*"Easier to use web tool, more intuitive, easier to navigate, easier to manage..."*

*"A single software program that all the company would use; this way info in support and numbers would be real time"*

*"Integrated, automated"*

*"A computer-based system that could share date from multiple points"*

*"We need a tool in which all functional groups are able to access"*

*"Provide a tool that would allow ease of tracking crews and equipment"*

## CONCLUSIONS

It would be hard to overstate the importance of excellent logistics for crew-care. The most important elements of crew-care necessities – food, lodging, and transportation to/from the outage areas are self-evident.

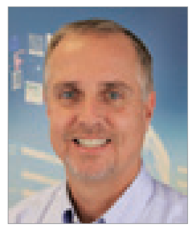
Our study shows that the systems in place to manage crew-care logistics are all too often mired in the past, which obviously has negative implications on quick power restoration.

It is easy to see why problems can arise, given the way this key component of incident resolution is treated. Less than one third of the companies in this study have personnel responsible for crew-care logistics on a full-time or part-time basis. Among companies which handle 10 or more emergency operations a year, only 36 percent have such personnel. Instead, they rely on assigning non-dedicated personnel to each outage, on an incident-by-incident basis.

As for coordinating lodging, food, fuel, transportation to and from work sites, creation of a base camp, monitoring/communicating changes in what has to be done as the situation evolves, and the countless other components of emergency outage incidents, most companies lag far behind the curve. This maximizes the potential for problems to arise, and for little problems to grow into big ones.

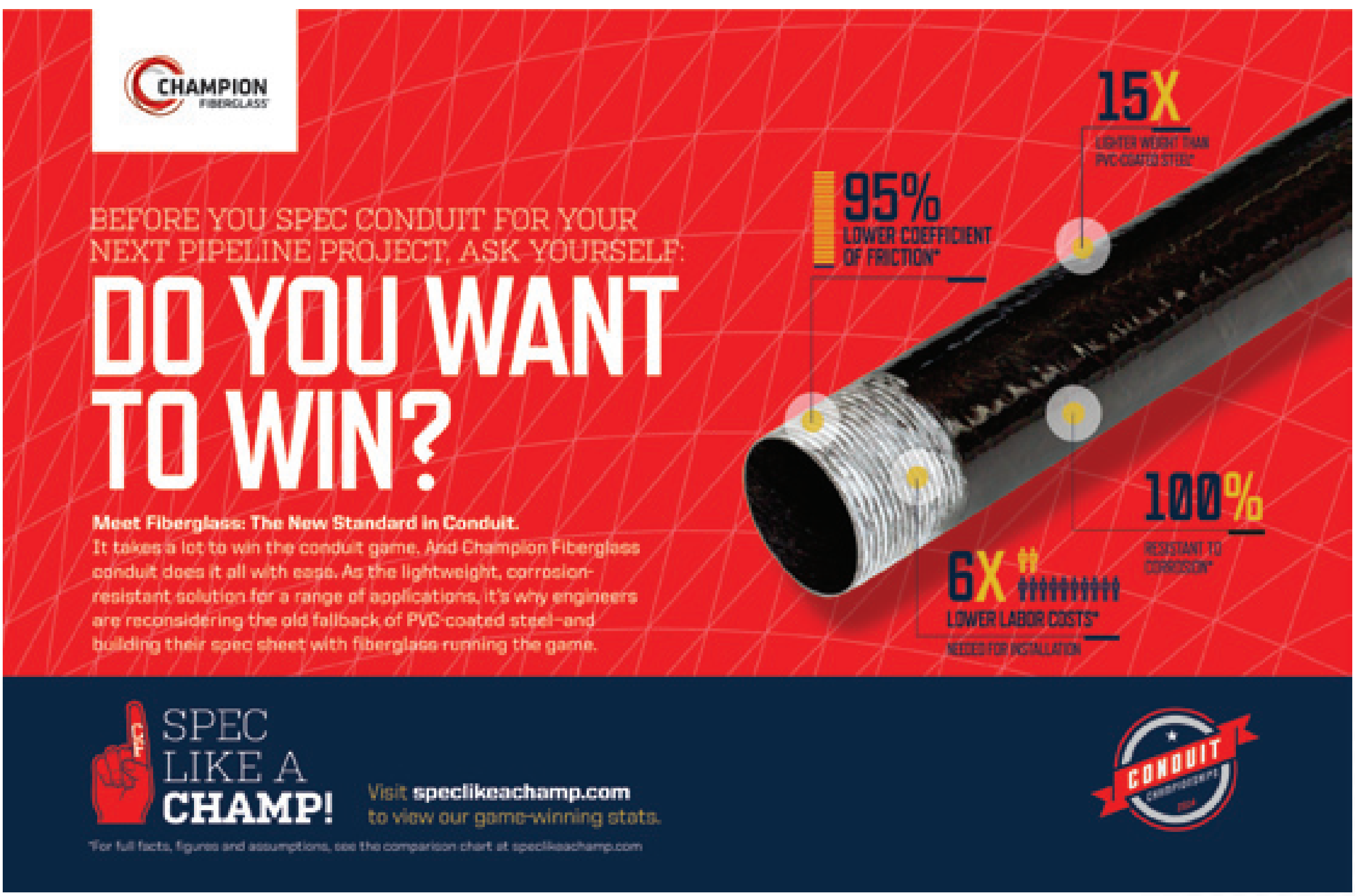
That is why it is inexplicable that, in an age of technology, only 26 percent of the people surveyed in this study use dedicated software to manage and coordinate crew-care logistics. Even among companies which handle 10, 20 or more incidents a year, only 36 percent do so with 16 percent still using white-boards and notepads.

Over 200 years ago Napoleon said an “Army Marches on its Stomach.” The same can be said for restoration crews today. If you expect excellent quality work under tight dead-lines from a busy crew of lineman, be sure your company has systems and processes in place to feed, lodge and care for the critical people who are restoring the power.



## About the author

**John Kullmann** is Vice President of Marketing and Sales at Macrosoft, a New Jersey Technology company. With more than twenty years’ experience, John is a recognized expert in business development efforts for professional services firms. He is responsible for expanding Macrosoft from its traditional roots as a leading software development and system implementation company into an equally accomplished provider of packaged technology products.



# THE BIGGER PICTURE

BY JASON TOWER

## What I learned from a bucket truck

### Disaster preparedness best practices from those who know

For the contactors, utilities, and cooperatives who use them, the platform of a bucket truck is likely to be associated with helping customers. In times of disasters – from the string of tornadoes in 2011, to the Northeast superstorm, to hurricanes and more – those trucks and the people who work from them represent hope and recovery. And that process is never simple, never easy.

Bringing restoration to thousands – or millions – requires expertise, experience and knowledge, something that the hundreds of people who use specialized products have learned over the years. While the winds are calm and weather gentle, now is the time to consider the perspective of experts, those who have learned from dealing directly with disaster.

### Communication

Often when thinking of communication, the focus is on what happens during an event, and it should be. But just as important may be developing some strong relationships and communication practices beforehand.

During the string of tornadoes in April 2011, cellular towers located throughout portions of north central Alabama were destroyed, making cell phone reception impossible or, at best, challenging. Coordinating efforts or even getting maintenance parts and equipment to where it was needed was difficult.

As crews worked to restore power, dedicated representatives were at a staging area at the Birmingham-Jefferson Civic Center, sourcing repair parts, diagnosing issues and providing on-site, on-time help. Several times a day, these representatives would meet with various foremen, who would let them know what was needed – replacement parts or repairs – and from there, techs could coordinate and find the parts needed to keep crews working.

"With cell service disrupted, crews had to rely on other things: CBs, two-way radios and word of mouth," said Brent Bridier, Service Representative. "What became important was having specific meeting places and locations to get supplies and help, and pre-planned processes for delivery."

With 16-hour days, contractor and utility crews providing recovery assistance were sheltered, organized and given assignments for the next day. Many of these crews were from out-of-state, so maximizing what was learned and needed in a short span of time was crucial, as was planning beforehand by the utilities to cooperate in restoration. If parts needed to be ordered, they were sourced from a nearby facility or ordered from Altec Parts Central Distribution, then delivered directly to the crew's work sites.

Cleveland Utilities, which services Cleveland and Bradley counties out of eastern Tennessee, is an active member of the Tennessee Valley Public Power Association (TVPPA). Associations like the TVPPA coordinate mutual aid recovery during natural disasters such as the tornadoes of 2011.

"With a 15-truck fleet and 60 percent of our customers without power after the tornadoes, we had no choice but to rely on aid from other utilities," said Bart Borden, Cleveland Electric Utilities Division Vice President. "Through the coordination of the TVPPA, we were able to easily source available crews throughout the southeast and have since returned the favor to some of the crews who helped us during that time."

And according to Borden, being prepared includes knowing who to turn to in recovery: "When crews come in to help, we always send someone who knows our systems with them – not linemen but meter readers, installers, etc. And if the event is large enough, we'll ask for help from retired linemen who know our practices and have been such a huge asset to us in the past."

"Having someone who you already trust ready to help, that's the best communication preparation possible," said Todd Neil, Global National Sales Manager. "The best way to prepare before disaster is to develop relationships with contacts before you need them. Know numbers, names and faces associated with your equipment, service and parts dealers. Know where your help will come from."

## Rentals

The utility equipment rental market is dynamic. Available equipment changes by the minute, especially during times of natural disaster. With the cost of equipment on the rise and the ongoing upgrades to the electric grid system, the market has seen an increase in rental demand.

Securing rental equipment before it is needed is critical. Immediately following a natural disaster, affected Altec customers receive a list of available rental equipment and can reserve what they need depending on the size and scope of the event. Other providers typically provide similar lists.

However, at that point, the demand is high and the supply fluctuates. "When it comes to securing equipment during a disaster, it's best to commit as early as possible," said Neil.

Contract terms are important to understand when making the decision to invest in rental equipment. When a recovery period is uncertain and a rental company charges based on a minimum term, the customer is then faced with making the decision to pay for a predetermined length of time without knowing how long they will need to use it.

Fleet managers often make the decision to use older, owned equipment for disaster recovery. The practice of utilizing older units to use during long hours of maximum capacity work load can be unreliable and cost the business in the long run. Recently serviced and inspected units that crew members are familiar with operating serve as the best trucks to have for recovery.

Equipment rental vendors will often work with companies to develop a customized rent/purchase program, which ensures the utility will have rental equipment available during hurricane season. These programs add extra equipment to the fleet purchase for the following year, but the extra 'storm pool' units are delivered before next year's delivery date. The utility pays the monthly rental fee for the availability of the equipment, but receives rental credit toward the purchase of the storm pool units on the following year's budget.

"Having a built-in insurance policy of storm recovery units, built to a utility's specification, that can be used in the event of a hurricane is wise," said Neil. "And having the pre-existing relationship is also beneficial to the customer."

## Keeping Trucks Moving

One thing that is true of any disaster is to expect the unexpected. Equipment will need maintenance; parts will be required and service techs will be in high demand.

"The best parts to have on hand for any emergency are common preventative maintenance and wear items," said Parts Representative, Matt Kennedy. "Digger derricks or material handling aerial units heading into a disaster area are much more effective with spare load lines."

From lifting transformers on a material handling aerial to placing poles on a digger derrick, load lines take a lot of wear and tear during disaster recovery. The common, yet incorrect, practice of 'flipping' a damaged load line on the drum can potentially lead to a major problem. Extra hydraulic fluid and filters as well as hydraulic hose and seal repair kits with field fittings that don't require crimping can handle on-site hydraulic leaks. Keep these parts available in a mobile parts and supply trailer that can be accessed from a central staging location.

Southern California Edison (SCE) provided mutual aid during Superstorm Sandy of 2012. Jim Wood of SCE Construction Methods team utilized two mobile service trucks equipped with a manager and two trained mechanics each, stocked with preventative maintenance parts, as well as equipment like portable welders and lubricant.

"My one regret is not bringing our own supply trailers," said Wood. "The utilities underestimated the amount of supplies they would need to distribute to recovery crews, so our guys had to wait on extra supplies like power poles and other line materials. Even if the trailer is never used, the amount of time you won't waste waiting for supplies is worth it."

Foothills Energy Services (FES) provided assistance to Mountain View Electric Association during the Colorado Black Forest Fires of 2013. An unprecedented event for that area, the crews worked 15 hour days for six weeks. President of FES, Steve Marr, now keeps extra flame retardant clothing on hand as well as air filters. Covered in soot and ash, the air filters needed to be changed once a day.

## On the ground and on to recovery

Sometimes, the lesson learned from a disaster is that having the right equipment or staffing makes all the difference. Bart Borden, Cleveland Utilities, added an Altec A77T following the devastating tornadoes of 2011. The utility assigned mutual aid workers to replace the 250 distribution poles that were down, while the city of Cleveland assigned their crews to restore their damaged 69 kilovolt transmission system.

"The 2,000 pound jib and the working height on the A77T would've been extremely useful to reach our 75 to 90 foot transmission poles," remarked Borden. "If we had that truck during the tornado recovery, we could have accomplished a day-and-a-half of work in about six hours."

Cleveland Utilities also invested in a collapsible reel to extend off the shaft of their front winch on the A77T. Instead of spending hours manually coiling damaged power lines, the collapsible reel is a cost effective way to maximize the productivity of a front winch on utility vehicles.

From trucks to people, mobilizing enough crew members can also make a difference. From his experience with Superstorm Sandy, Wood, Southern California Edison, recommends adding an additional crew member to each vehicle to ensure a safer, more productive recovery effort. Now, they send one digger derrick for every three aerial devices with one foreman, two linemen and one groundsman.

And while the focus during a crisis may be on restoring utilities and serving the needs of the community, making sure that the people who are doing the work of restoration are taken care of is just as important.

"Safety items," said Tony Gaede, The company's Supply Manager. "Ground flags, safety signs and stands, lights and rainwear… and personal voltage detectors, such as V-Watch. Customers need to have plenty of these and make sure they are in good working condition."

"The relationship between vendors and local utilities really shines in these times," said Dwight Johnson, Mobile Service Technician. "Providing a common point of reference for contractors – like a website set up by utilities – can help source assistance and supplies, from local vendors, to hotels, fueling locations and more."

In the end, the purpose of being prepared is to make the restoration quicker and safer. The point of planning ahead is to remove minutes, when minutes count. It's people who work the lines, trucks and poles when the work of restoration begins. And it's the people who ultimately make a difference.

"We can talk about trucks and maintenance and restoration, but the most important thing all of us can do is provide the safest, most efficient recovery environment possible, so the real heroes can get out there and do their jobs," noted Gaede.

ABOUT THE AUTHOR

**Jason Tower** has been in the utility equipment manufacturing industry for 12 years and currently serves as Altec Service Group Market Manager. His focus is to expand the company's service foot print through determining marketing segments and market share in order to shape strategy for continuous growth.


With William T. (Tim) Shaw
PhD, CISSP / CIEH / CPT

# SECURITY SESSIONS

## You say potato and I say potato – but I didn't actually mean it!

Way back in 2003, not long after the country had gotten back on its feet after the horrible impacts of the terrorist events of 9/11, the NERC board of Trustees issued Urgent Action Standard 1200 addressing cyber security. The goal of that standard was to get back an essential portion of our critical infrastructure: the electric grid, some basic protections against terroist attacks, and specifically terrorists using a cyber means of attack. Here we are more than ten years later and NERC and the electric utilities are still arguing over minutia and the interpretation of words in the CIP standards that eventually replaced the origianal standard. But are we any closer to having a cyber secure bulk electric system?

In 2003 when NERC took its initial steps towards securing the electric grid against a terrorist (possibly cyber) attack the focus of that effort was aimed at protecting the SCADA/EMS systems that monitor and control the grid and the individual regions and service areas of the large electric generating utilities. The standard did not specifically say that, but you could read between the lines of the requirements and come away with that interpretation. The standard merely said to identify and protect the critical cyber assets, whatever you believed them to be. There were no criteria specified to aid in making the determination of what qualified as a critical cyber asset (CCA) and so many (most?) utilities figured that it had to be the systems that monitored and controlled the grid – their SCADA/EMS systems. The requirement asked for entities to define and establish both a physical and electronic security perimeter around those assets. That was a reasonable request if again you interpreted the requirements as being your SCADA/EMS system. It was probably located in a single facility (possibly with a backup facility located elsewhere) where you could reasonably provide physical security protections. And it was probably also reasonably straight forward to put cyber security protections in place on any external connectivity with corporate systems, regional authorities and adjacent grid entities. But because of the lack of specific definitions of 'critical cyber assets,' or criteria for determining what qualified as one, most utilities elected a 'wait and see' attitude.

A year later NERC issued an update called *Standard 1300 – Cyber Security*, which was intended to add clarity to the cyber and physical security requirements previously called for in *Standard 1200*. In that new document it clearly stated that a critical cyber asset was one that 'performed critical bulk electric system functions such as telemetry, monitoring and control, AGC, load shedding, black start, real-time power system modeling, special protection systems, power plant control, substation automation control, and real-time inter-utility data exchange…' That clearly upped the ante on the electric utilities. Now clearly the scope of the standard had been extended well beyond merely protecting the SCADA/EMS systems (although most of those criteria just listed refer to such systems). Based on this more specific set of criteria a utility might also have to look at the digital systems and devices used in its generating facilities as well as in their transmission and grid intertie facilities – a much bigger nut to crack! But like all good corporations the electric utilities had a choice to make. They could turn to their IT and engineering departments and figure out how to do what NERC wanted or turn to their legal departments and start a delaying action that could postpone the cost and manpower required for implementation for an extended period of time. I don't think I need to tell you what most of them choose. Back in that timeframe I was working as a consultant to several utilities and most had just one question for me: what is the minimum we can do to look like we are complying so that we don't get hit with a fine?

If you were on the front lines back then you know that there was a massive barrage of questions, complaints, requests for interpretations and for exceptions launched at NERC by the electric utilities. It became clear that the 1300 standard was being misinterpreted (possibly intentionally) by electric utilities who were trying to minimize the number of CCAs and facilities they had to deal with under the revised standard. NERC took all of this feedback and in 2006 they replaced the single 1300 standard with the eight individual CIP standards (CIP-002-1 through CIP-009-1), partially so that some portions of the requirements could be isolated from the on-going battle of words, much of which continued to focus on how to interpret the definition of CCAs so as to minimize the number of CCAs. Over the next few years, right up to the recent introduction of revision 5, the folks at NERC and the utilities have continued to argue over how to parse and interpret the meanings and intentions of the words in the CIPs in order to find (if you are a utility) or close (if you are NERC) the potential loopholes. There are actually people who have blogs dedicated to the rehashing and reinterpretation of the wording of the CIP standards. I participate in several LinkedIn® on-line chat groups and the run up to the release of the latest CIP revisions caused almost as much email and message traffic as has the reaction to and dissection of the actual revised standards. In a prior revision the standards introduced the idea of a using a given power level as a means for diving CCAs into different groupings (If the loss of a facility/CCA could impact the bulk power grid by greater than X MWs then it was a more important facility/CCA.) Rather than this aiding utilities in making a determination of what was/wasn't a CCA numerous utilities took this as a challenge and began trying to treat their individual units in a multi-unit generating plant as being separate, in order to fall under that power level.

Now I am all for fighting against unreasonable and useless regulations, and I respect every corporation's right to improve their profitability by eliminating unnecessary costs. But I can't imagine that any electric utility would actually be willing to risk being hit by a cyber attack that could cause outages, cause harm to the public, the environment or that would cause harm to their own facilities and infrastructure. So the question that arises is – do electric utilities believe that a cyber (or physical) terrorist attack on their digital systems and networks can't happen, or that it is so unlikely to happen as to be beneath consideration? Or is it that they believe themselves to already be adequately protected against any realistic form of cyber attack? (This latter position would imply that they feel the CIPs to be excessive and [well?] beyond what is reasonable for adequate cyber/physical protection.) Electric utilities have always had to deal with reliability and availability and they have programs and procedures in place to get the power back on when bad things happen. Possibly they believe that this existing ability would be adequate to keep a cyber attack, were a successful one to actually occur, from having wide-spread, and disastrous consequences. Could a cyber attack really be any worse than a hurricane? And to date there have not been any publicized successful cyber attacks on U.S. electric grid CCAs, but lots of hurricanes, so which is really more of a threat? (Yes, I did place a couple of important intentional qualifiers in that last sentence.)

One factor that I have experienced almost universally when I discuss cyber threats and attacks with utility personnel is that they don't really comprehend the range of potential consequences of a well-executed cyber attack. Invariably I hear them discuss the failure of systems as a result of a cyber attack (but not compromise). Utility personnel responsible for grid reliability have decades of experience and data that help them guestimate the likelihood of a major component undergoing a failure. They can tell you how many operations a circuit breaker can handle prior to failure, and even how weather can impact that figure. They can tell you how much power their conductors can handle and the maximum wind shear a transmission tower can handle. But they actually have no experience with or, in most cases, an understanding of the consequences of a cyber attack.

I like to explain cyber attack consequences to a computer-based control/automation system as being like having an invisible, smart, homicidal maniac in the control room of an EMS/SCADA system or a generating plant, watching as operators use their graphic displays to issue control actions, and then reaching over their shoulders and pressing the buttons on the display screens to see what they can make happen. The last thing they would want is for the system to fail and end their fun. But utility personnel argue that their critical systems are isolated, or based on obsolete technologies, or adequately protected by the corporate IT folks, and thus the maniac (or malicious hacker) could never get to these systems and take such actions. Well, both I and NERC hope that is true. Point in fact, that is what the CIPs are trying to ensure. Unfortunately in all the arguments over the meaning of the word 'facility' the objective of keeping important systems adequately safe from cyber attack, seems to have been lost. (Of course utilities and NERC still don't see eye to eye on the definition of the term 'adequate'.)

There was a cigarette commercial on TV (remember those?) many years ago where actors playing dedicated smokers exclaimed that 'they would rather fight than switch.' As long as electric utilities feel that that the NERC CIP requirements are excessive and unrealistic I expect many will continue to argue and delay rather than comply. Of course if a major cyber incident that impacts the grid actually occurs (especially at a utility that has been fighting the CIP standards) that could change everything. But that will have to be the subject matter for a future column.


## ABOUT THE AUTHOR

**Dr. Shaw** is a Certified Information Systems Security Professional (CISSP), a Certified Ethical Hacker (CIEH) a Certified Penetration Tester (CPT) and has been active in designing and installing industrial automation for more than 35 years. He is the author of Computer Control of BATCH Processes and CYBERSECURITY for SCADA Systems and co-author of the latest revision of Industrial Data Communications. Shaw is a prolific writer of papers and articles on a wide range of technical topics and has also contributed to several other books. Shaw has also developed, and is also an instructor for, a number of ISA courses and he also teaches on-line courses for the University of Kansas continuing education program. He is currently Principal & Senior Consultant for Cyber SECurity Consulting, a consultancy practice focused on industrial automation cyber security and technologies. Inquiries, comments or questions regarding the contents of this column and/or other security-related topics can be emailed to timshaw4@verizon.net.

# Data Analytics: Finding the Hidden Value behind Your Utility's Data

Guest Editorial

By Brian Crow

It's safe to say that outage management is a top priority and concern for electric utilities. For example, consider what happened to an electric utility located in the middle of the country's infamous 'Tornado Alley.' After a series of devastating storms and tornados hit, the utility's transmission and distribution systems were seriously damaged. However, by combining meter data with its outage management system, the utility was able to complete all repairs to its transmission and distribution systems within a month. In addition, the technology integration helped the utility enhance its customer service by restoring power and resuming operations in record time.

This is just one example of how proper data management and the use of data analytics can help utilities maximize the value of all the data that their sensors are providing them to draw insights, identify current or potential issues, and enhance operations.

## Getting Started

There is no denying that we live in an age of information. What really matters, however, is what we do with this information. After all, the information on its own is just that—data. As utilities adopt communication systems to improve their operations, these networks are delivering a growing volume of data from both the utility's infrastructure as well as external sources such as news and weather aggregators. As a result, utilities are struggling to manage and determine how to best use this surge of information. However, through the use of data analytics, utilities can now better manage this information and, ultimately, improve system efficiency.

To optimize the value of data analytics, there are three steps that utilities should follow:

1. Collect the data
2. Analyze the information
3. Convert data into actionable insights

## Collect the Data

Communication networks provide utilities with data about power usage, the utility's infrastructure and even outages. While this information is useful, utilities are now asking:
"What else can this information tell me? Is there an opportunity to use this information to improve system operations?" Utilities need to consider the other sources of data that they could be tapping into for a more comprehensive view of their system and operations.

Another key benefit is that data collection improves coordination, breaking down the walls between different utility departments. More specifically, the actions of one department often affect the entire utility and data analysis helps to showcase this. For instance, customer service may have limited interaction with the operations department, and data collection and analysis enable every department to see the big picture. Through the use of data collection and data analysis, every department is able to work together to improve operations for the utility as a whole as well as benefit its customers.

Utilities and their customers are craving basic data and visualization such as charts, graphs and online dashboards. With data analytics solutions, utilities can quench this thirst and realize even greater value hidden within this information. If one department in a utility begins to implement data analytics, other departments will see the results, embrace it and the walls will come down.

However, while sensors on the communication network provide utilities with this data, collecting the information is just the first step.

## Analyze the Data

As the example above revealed, sharing data across departments within a utility can often address problems such as customer-related issues. While this type of data analysis is useful to utilities, the real challenge lies in transforming this data into information that will benefit the utility and its customers.

Utilities have two main options for how to analyze this data:

a) They can either build a system in house
b) They can choose to source an outside data analytics vendor

# Data Analytics: Finding the Hidden Value behind Your Utility's Data

There are certainly challenges and benefits with both options. When building a system internally, utilities have more control. More specifically, they have the ability to completely customize their data analytics system and do not have to try finding the right vendor to partner with. On the other hand, building an in house system also poses certain challenges and obstacles, particularly for smaller utilities. For instance, a system might require buy-in across several departments within the organization as well as require numerous resources to maintain it. For smaller utilities, they might not have access to these resources, making this option less advantageous. And let's not forget that, while data drives tremendous value, the IT and business processes necessary to derive that value can be complex.

The second option is to work with an outside vendor. Data analytics is an evolving space; if a utility sources an outside vendor to supply and manage its data analytics system, software updates, for example, are seamless to implement. In addition, many utilities and especially IOUs have internal constraints to deal with. Very often, they cannot take the risks required to advance their own data analytics campaigns. In addition, smaller utilities oftentimes do not have the resources necessary to build a system in-house, making working with an outside vendor even more ideal.

Regardless of which option you choose, implementing data analytics allows utilities to continuously review, monitor and verify data. And the benefits are limitless. One major benefit is that utilities no longer need to continuously monitor data on their own. Data intelligence provides a series of routines to assure multiple checks and balances of the data. By using routines that verify data, utilities can expect to save both time and money.

This data intelligence also allows the utility to assign the appropriate action to automatically adjust to any perceived discrepancies in the data. Utilities can pre-select responses and organizational tactics for different types of incoming information. This continuous and instant monitoring allows utilities to run more efficiently and better serve their customers. Data analytics can also immediately alert customers of certain occurrences or issues, helping improve response rates and enhance customer service. Customers can receive automated notifications and alerts at the very moment something is wrong. This type of automated notification can cut response rates and increase operational efficiencies, enhancing customer services as a result. In this age of technology, this rapid response is not just wanted by customers, it's expected.

Given the ever-changing nature of the electric industry, data analytics provides flexibility through vast customization options to address the varying skill sets and needs within a particular utility. In addition, such agility allows for enhanced integration of complex networks. With data intelligence, utilities can solve nearly any data-related issue while also incorporating a sophisticated platform that can address more complex needs.

For utilities, another significant benefit of data analytics is revenue forecasting. With the ability to bring in meter data every fifteen minutes, compared to just once a month, utilities can track their earnings in real time. Additional benefits include pulling customer information, better managing the business, segmenting sales data via customer classes and estimating budgets to conserve costs and improve operations.

## Convert the data into actionable insights

With the massive influx of data that utilities receive on a daily basis, a key part of data management is being able to sort through all of this information and pull in actionable insights. To truly benefit from such a large amount of data, utilities need to determine what data is required to best improve operations, reduce costs and enhance customer service.

## Reap the Benefits of Data

The combination of data management and analytics enables utilities to take a system-wide view of their operations. It also allows utilities to better serve their customers by turning data into actual intelligence. With the right data analytics solution in place, utilities can manage their data and, most importantly, use this information to improve their utility and benefit the customer.

Data analytics can also provide environmental and societal benefits. Utilities can monitor customer usage and educate customers on their consumption. More specifically, data analytics can provide customers with regular alerts on their energy usage. With improved communication to customers about their energy consumption, self-initiated conservation can take place.

Ultimately, if utilities want to maximize the benefit of the data they receive from their sensors, data analytics is key. By collecting the data, analyzing its information and pulling actionable insights, utilities can gather information from grids, infrastructure and external sources to improve operations, reduce cost and inefficiencies, and enhance customer service. Every utility has unique challenges but, for many, the solution lies in the packets of data that travel over their communication network.


## ABOUT THE AUTHOR

Brian is an 18-year utility industry veteran whose entire career has been focused on finding solutions to the challenges utilities face across their enterprise. Prior to joining Verdeeco, a Sensus company, Brian worked for the SAS National Utility Practice where he focused on providing utilities with analytic products such as load forecasting and energy trading risk measurement. Brian is a licensed Professional Engineer in the State of Georgia and received his BSAE degree from the University of Georgia.

Guest Editorial 2

# Firming up the grid, and supporting it with renewables

By Patrick Frigge

The deployment of advanced distributed power technology is critical to the establishment of more flexible and dependable decentralized energy power supplies around the globe.

In fact, decentralized power is filling the needs of both developed and developing nations. On the one hand, decentralized power is in growing demand to stabilize the grid in developed countries, and greater generating flexibility is necessary to meet the needs of the rising renewables segment. On the other hand, remote locations can be serviced through distributed power without the time and cost of setting up transmission and distribution networks.

## Premium flexibility, unlimited scalability

GE's flagship gas engine fits these scenarios. It has the highest-in-class simple-cycle efficiency at 49 percent to lower investment and operating costs. It also offers efficiencies of more than 90 percent for combined heat and power (CHP) in a plant application that produces hot water, thanks to two-stage turbocharging. The turbocharging feature allows the GE gas engine to attain up to 3 percentage points higher total efficiency than gas engines that only offer single-stage turbocharging. And, there is no compromise on efficiency even in high-altitude and tropical regions. Since the engine is a modular system with a compact footprint, it's scalable to any plant size and takes little time to install.

**GE's 10 MW class J920 FleXtra engine is part of the Stadtwerke Rosenheim municipal cogeneration plant in Germany**

Because of their rapid start/stop cycles (the pre-heated engine has a five-minute startup time) and the excellent flexibility for baseload, cycling and peaking operation that comes from running multiple units simultaneously, the latest units provide strong power generation, district heating, decentralized independent power supply in remote areas and harsh environments, and grid stabilization for renewables support.

Since there is a great deal of dispatch volatility these days, gas engines face challenges with transient performance and compliance with grid codes. Without sacrificing plant efficiency or startup reliability, power plants must have fast-load tracking capabilities to meet peak demands and the need for ancillary services. The technology is designed for these challenges, as it includes a cylinder-individual combustion control system that uses in-cylinder pressure sensing, distributed controllers with imbedded software, and individual cylinder gas supply through port injection. These features enable the engine to provide load following, automatic generation control, and supplemental reserve without disrupting maintenance schedules or raising service costs.

The power generation mode embodied in this new gas engine also is a timely response to emerging global power demographics. Worldwide, energy power supply efficiency is only 33 percent, but the European Union has called for achieving 20 percent cuts in greenhouse emissions and primary energy consumption and a 20 percent gain in energy efficiency and the renewable portion of power generation by 2020.

With its large portfolio of gas engines, GE's Distributed Power business offers the advanced technologies that deliver CHP, gas compression and waste heat-to-power electricity generation. These are the types of installations that are shaping the emerging low-emissions, smaller-scale, flexible power landscape that emphasizes efficiency in the production and delivery of heat and power.

Cases in point abound. For instance, the CHP technology cuts CO emissions at the Bitburg brewery in Germany by about 10,000 tons and has saved 10 percent on primary energy consumption since 2005. Three cogeneration units that supplied the 2012 London Summer Olympics with 10 MW of heat, power and cooling are continuing to heat and power homes and businesses in East London. A biogas agricultural power plant in Rawa Mazowiecka, Poland, runs on two units whose total efficiency is 86.6 percent. Poland's largest flower grower is using CHP technology to post primary energy savings of about 40 percent in generating heat and power for its greenhouses.

## CHP advantage: ramping up or down, as needed

There is a strong worldwide push for more wind and solar power; since 2010, installed capacity of these kinds of non-dispatchable installations has doubled, and that trend likely will continue. The right kind of power generation is necessary to support wind and solar energy within a stable grid. Flexible sources like this new engine can be activated when wind and solar supplies are slack or during tariff spikes and they can be cut back when energy prices fall and renewable power is plentiful.

That's what's happening in CHP plants that combine Jenbacher gas with heat storage. To a certain extent, the heat storage allows flexible power production in combination with a continuously required heat supply, so the CHP plant can be operated more flexibly. In a low-price or high-renewables environment, the plant reduces load and heat storage meets the heat demand. In a low-heat-demand or high-tariff situation, the gas engines supply the power and store heat for later usage. Hence, the heat storage affords a high level of operational flexibility that complements the use of wind and solar farms.

The beauty of CHP, as manifested by GE's options, is its applications versatility, whether for district heating plants or the decentralized supply of power and steam or power and heat. In every case, primary energy savings are significant, when compared to separate production. An engine in operation uses the oil, mixture coolers and exhaust heat and waste heat from jacket water cooling to furnish the heat in a CHP plant. When heat and power are produced separately – the power coming from the national grid and heat from boiler generation – at least 50 percent more primary energy is consumed than by CHP. In one year, the J920 engine would use 130 million kWh less primary energy input than a plant that generates heat and power in separate formats. That's equivalent to the energy produced by more than 76,000 barrels of oil.

Germany is a textbook example of the CHP dynamic in action, where CHP plants equipped with heat storage systems are complementing the environmentally beneficial but intermittent wind and power resource. Through the mechanism of the Renewable Energy Law passed in 2000, these facilities are being specifically subsidized in the interest of efficiency and emissions control, with guaranteed feed-in tariffs assigned to power that's generated from renewable resources.

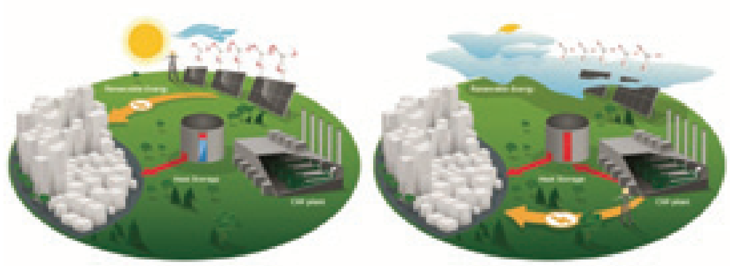
At the Stadtwerke Rosenheim, a German municipal CHP plant demonstrates how well the interplay of GE's gas engines and the availability of renewables work to balance out the grid. It's a typical plant of its kind, in that it supplies water, electricity, gas, process steam and district heating to residential and industrial customers. By adding the gas engine in 2012, the plant generates about 40 percent of the town's electricity and about 20 percent of its heating.

In recent years, many Rosenheim residents installed rooftop solar panels, which can supply up to 10 MW to the local grid. But to account for weather-induced spikes in solar power, Rosenheim needed fast-reacting power generation from GE's gas engines to stabilize the grid. Because the new engine is just as flexible as a smaller gas engine, with much higher electrical efficiency, it's always the first engine to dispatch for peaking power in the city.

With the CHP plant storing heat in hot water tanks, the gas engines don't have to operate all the time, and homes can stay warm without the reciprocating engines being run. When wind and power are abundant, the plant switches to them, and when district heating isn't necessary, the engine supplies peaking and balancing power to the city's grid.

## Meeting the Grid Code Challenge

GE's advancements in reciprocating engine technology also are meeting the challenge created in Germany by that country's adoption of power supply network and system regulations known as the grid code – a phenomenon that other EU countries are adopting, though not to the extent of Germany. That was promulgated in 2013, when German energy suppliers had to begin assuring that national grid fluctuations wouldn't adversely impact power generation and that the power plants themselves would enhance network stability. Under the new rules, the utilities that feed the grid must react within milliseconds to voltage drops and stay online even during grid instability Otherwise, the suppliers that fail to do this would be dropped from the grid – an event that could trigger a regional network breakdown and a widespread blackout.



**CHP Plant operation with heat storage in conjunction with renewable power generation**

The move to a grid code tracks Germany's shifting energy stance that is emphasizing more alternative energy. Here, grid stability is more challenging for the likes of wind farms or photovoltaic collectors than for large-scale, stable power generating plants. This trend is also important beyond Germany, since the rules that country has implemented to provide decentralized energy supply within a dynamically stabilized grid will be pertinent throughout Europe. In fact, the first plant in Europe to support complete dynamic grid stability, and be grid code-compliant, became operational in 2010 in Mâcon, France, in a CHP configuration with three Jenbacher gas engines.

Not only are innovative technologies that neutralize grid volatility being made available on new units, but they also can be found on engines that are overhauled in the Jenbacher Overhaul Technology Center. GE's Jenbacher solutions are conforming to the grid code reality by providing static and dynamic grid support -- and helping to shape the new energy order around the globe.

## ABOUT THE AUTHOR

As of October 2013 **Patrick Frigge** is leading the 10 MW reciprocating engines Product line platform as General Manager for GE's Distributed Power. Within this role he is also responsible for GE's latest gas engine that was commercially introduced in April 2013. Prior to joining GE, Patrick was Director of Research and Development of Wärtsilä Switzerland Ltd. In this position, which he began in 2008, Patrick lead the central research and development unit for Wärtsilä's newly developed two-stroke engines. .

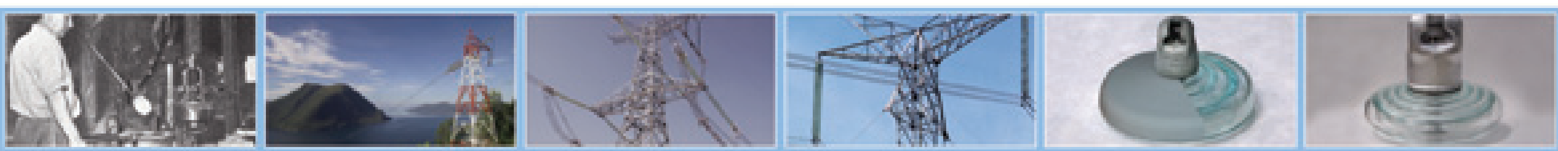
He has a master's degree in industrial engineering and management from the Technical University in Berlin, Germany.

Distributed Power, which is focused on power generation at or near the point of use, is part of GE Power & Water, an operating unit of General Electric Company (NYSE: GE) and a world-leading provider of power generation, energy delivery and water processing technologies serving all areas of the energy industry, including wind, solar, biogas, alternative fuels, natural gas and nuclear energy.

# PRODUCT SHOWCASE




# ADVERTISERS INDEX

| 1947 | 1973 | 1979 | 1984 | 1996 | 2011 |
|---|---|---|---|---|---|
| **Glass insulator toughening process** > 500 million insulators | **River crossing with 120 klbs glass insulator** > 2 million insulators | **Glass insulator for Ultra High Voltage** > 14 million insulators | **High Resistivity glass insulator for HVDC** > 6 million insulators | **Silicone coated glass insulator** > 1 million insulators | Bulk power transmission with **170 klbs glass insulator** |

SEVES

SEDIVER

Thanks to our experienced R&D, cutting-edge test facilities and state-of-the-art manufacturing, Sediver has always been a partner of choice for customers facing new challenges in HVTL insulation requirements. An installed product base of 500 million insulators worldwide in more than 150 countries and the most extreme environments gives Sediver unique expertise to provide solutions for every conceivable situation - and gives you, the Customer, invaluable peace of mind.

Contacts:

**Seves Canada:** info.canada@sediver.com - **Seves USA:** info.usa@sediver.com

www.sediver.com


Smart grid projects can be deceiving.
The ultimate Smart Grid vision portrayed by many still remains nothing but a panacea. If you are interested in a practical, pragmatic vision of the Smart Grid and need your vision successfully realized, make us your partner. If you want results instead of reports or marketing campaigns and want a Smart Grid strategy which is sustainable both post implementation and year after year, make us your partner. We'll help you plan and execute a realistic yet sensible vision of your Smart Grid strategy beyond smart meters and data warehouses, articles, press releases, commercials, speeches and odd partnerships.
Join the large number of utilities who, with our help, are quietly and solidly realizing their true Smart Grid vision.
OSI
We'll get your project down to size.
osii.com
© 2014 Open Systems International, Inc. All rights reserved.